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Thesis

THE ENDOCRINE SYSTEM OF THE GOLDEN HAMSTER  
(CRICETUS AURATUS WATERHOUSE)

BY

Julian Gilbert Snyder

(A.B., Boston University, 1947)

submitted in partial fulfilment of the

requirements for the degree of

Master of Arts

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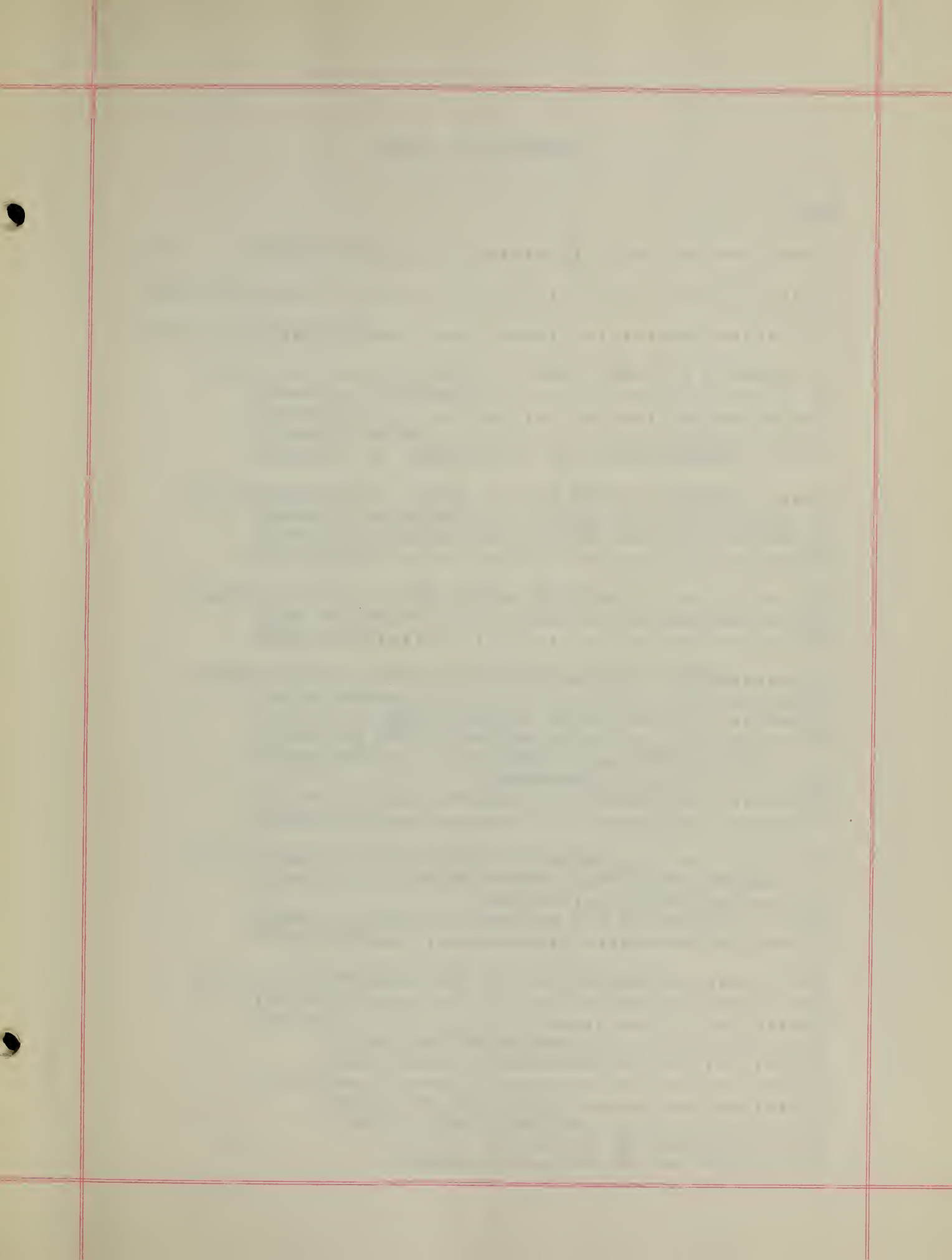
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# RESEARCH REPORT

1970

1. The purpose of this study was to determine the effect of the new curriculum on the students' learning.

2. The study was conducted in a classroom of 25 students.

3. The results of the study showed that the new curriculum had a positive effect on the students' learning.

4. The study was limited by the small sample size and the lack of control group.

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2. The second part of the document outlines the specific procedures for recording transactions. It details the steps involved in the accounting process, from the initial entry of data into the system to the final review and approval of the records.

3. The third part of the document provides a detailed description of the various types of transactions that may be recorded. It includes examples of common transactions, such as sales, purchases, and transfers, and explains how each type should be properly recorded.

4. The fourth part of the document discusses the importance of regular audits and reviews of the records. It explains that audits are necessary to ensure that the records are accurate and complete, and to identify any potential areas of concern or fraud.

5. The fifth part of the document provides a summary of the key points discussed in the document. It reiterates the importance of accurate record-keeping and the need for regular audits and reviews.

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## INTRODUCTION

The Syrian or golden hamster (Cricetus auratus Waterhouse) is being used more and more extensively in the laboratory. Several attributes of the animal make it well suited for experimental work. For example, the hamster has the shortest gestation period of any mammal known, sixteen days; it can breed frequently; the litters are large, from eight to eighteen; and the hamster is relatively clean as compared to the rat and other rodents. All of these qualities combined provide an animal that is eminently suitable for various fields of physiological investigation.

A survey of the literature discloses that with the exception of the reproductive system, little or no work has been done on the morphology or the physiology of the endocrine system of the golden hamster. Many papers have been published on the importance of the European hamster (Cricetus cricetus L.) in relation to agriculture, but these are not reviewed in this thesis, since I consider them outside the present topic.

I shall present a survey of the available literature dealing with the estrous cycle of the hamster, the action of sex hormones on the estrous cycle, the hormonal modification of sex development by various sex and gonadotrophic hormones, the cyclic seasonal activity of the endocrine glands, and the relation of sex steroids to the adrenals. The chief difficulty involved in the preparation of this paper was the lack of con-

## APPENDIX

THE STATE OF NEW YORK, in SENATE,

January 15, 1884.

REPORT OF THE COMMISSIONERS OF THE LAND OFFICE,

IN ANSWER TO A RESOLUTION PASSED BY THE SENATE,

PASSED MAY 15, 1883.

ALBANY: PUBLISHED BY THE STATE OF NEW YORK, 1884.

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firmation, in the literature and the scarcity of publications upon any of the above mentioned topics. Therefore, I shall present the work done for what value it may have, and attempt to evaluate as much of it as I can.

As can be surmised from the foregoing paragraph, much remains to be done in the field of endocrinology of the hamster. To that end, I have conducted a series of bilateral adrenalectomies upon the hamster, and have presented the findings, observations, and conclusions derived therefrom in the body of this thesis.\*

\*I am indebted to Dr. Leland C. Wyman of the Boston University Biology Department for his invaluable advice and assistance in the developing of the operative techniques and in the conduct of the investigation.

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## CYCLIC SEASONAL ACTIVITY OF THE ENDOCRINE GLANDS

Kayser and Aron (1938) investigated the cyclic seasonal activity of the anterior pituitary, the thyroid, the adrenal cortex, and the male genitals of the European hamster, Cricetus frumentaris. Their observations are included in this paper because the golden hamster goes into pseudo-hibernation, beginning in October and ending in March.

### Anterior Pituitary

In March, the anterior pituitary exhibits a very compact parenchyma, with the eosinophil and chromophil cells in very great majority as compared with the chromophobe elements. The eosinophil cells have a voluminous cytoplasmic body.

In September, the parenchyma is made up of cordons of tightly knit lobules of cells, interspersed with enlarged conjunctivo-vascular spaces. All the cells are much smaller than in March and contain a cytoplasmic body, which forms a shallow bed around the nucleus. The chromophobe type cells predominate. The groups of eosinophil cells are more spread out and scantier than in March, while the shape of their elements are in contrast to that which they had at that time.

### Thyroid

The thyroid is extremely active in March, with the vesicles of the epithelium thickened and the colloid hollowed

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[The following text is a memorandum of understanding between the Department of Chemistry and the [Organization]. It outlines the terms of a collaborative research project between [Name] and [Name]. The project will focus on the study of [Topic]. The results of the project will be shared with the Department of Chemistry and the [Organization]. The project will be completed by [Date].

Signed

[Signature]  
[Name]  
[Title]  
[Department]  
[University]

by numerous and large vacuoles of absorption. In September, the thyroid displays little or no activity. The vesicles are thin, the colloid dense, and no vacuoles are present.

### Adrenal Cortex

In March, the reticular zone of the adrenal cortex is composed of large cells, squeezed one against the other in many beds, where narrow capillaries circulate.

The histological picture is changed in September. Narrow rows of small cells border relatively large conjunctivo-vascular spaces.

Lipids were observed in March, but never in September. The animals displays a decline in activity between March and September, and the reverse between September and March. The evolution of the anterior pituitary precedes that of the thyroid and the testes.

### Relation Of Temperature To

#### Hibernation

It was found that the period of hibernation of the hamster may be lengthened or shortened by varying the environmental temperature. Increased temperatures cause the testes of animals, about to undergo hibernation, to show renewed spermatogenic activity. The eosinophil cells of the pituitary showed pronounced granulation upon the increase of environ-

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mental temperature; the pancreas, thyroid, and adrenal remained involuted.



## THE REPRODUCTIVE SYSTEM OF THE GOLDEN HAMSTER

### Normal Development

Ortiz (1947) made the following observations upon the post-natal development of the reproductive system. In both sexes, the development of the entire system is slow during the first two weeks. There is a sudden acceleration of growth between the sixteenth and twenty-sixth days. In the female, the vagina opens when the body weight approximates eight grams (at about the tenth day). Follicular antra first appear at twenty-six days. At thirty days the first spontaneous estrus occurs. Corpora lutea are formed by the thirty-sixth day after birth.

In the male, beginning at sixteen days after birth, the tubules of the testes form lumina. At sixteen days, the ventral prostate acquires light areas, as the seminal vesicles do at twenty-six days. By twenty-six days, all the male accessory glands have reached their adult histological condition and there is evidence of secretion in the seminal vesicles and coagulating glands. The testes descend at about the twenty-sixth day, while sperm heads appear by the thirty-sixth day.

### Hormonal Modification Of Reproductive System

The ovaries are first stimulated by gonadotrophin at ten days after birth. Hormone production and weight of the gland is increased. The reactivity of the ovary reaches its

# THE HISTORY OF THE UNITED STATES

## AMERICAN HISTORY

CHAPTER I. THE DISCOVERY OF AMERICA

The discovery of America by Christopher Columbus in 1492 is one of the most important events in the history of the world. It opened up a new world of discovery and exploration, and led to the development of a new civilization. The discovery of America was the result of a combination of factors, including the desire for wealth, the desire for knowledge, and the desire for power. Columbus's voyage was a bold and risky one, and it was only through his persistence and determination that he was able to reach the New World. The discovery of America was a turning point in the history of the world, and it led to the development of a new civilization. The discovery of America was the result of a combination of factors, including the desire for wealth, the desire for knowledge, and the desire for power. Columbus's voyage was a bold and risky one, and it was only through his persistence and determination that he was able to reach the New World. The discovery of America was a turning point in the history of the world, and it led to the development of a new civilization.

CHAPTER II. THE EARLY YEARS OF AMERICAN HISTORY

The early years of American history are a period of great discovery and exploration. The first European settlers arrived in America in 1492, and they began to build a new civilization. The early years of American history were a time of great hardship and struggle, but they were also a time of great achievement. The early years of American history were a time of great discovery and exploration. The first European settlers arrived in America in 1492, and they began to build a new civilization. The early years of American history were a time of great hardship and struggle, but they were also a time of great achievement. The early years of American history were a time of great discovery and exploration. The first European settlers arrived in America in 1492, and they began to build a new civilization. The early years of American history were a time of great hardship and struggle, but they were also a time of great achievement.

## CHAPTER III. THE DEVELOPMENT OF AMERICAN HISTORY

The development of American history is a process that has taken place over the centuries. The early years of American history were a time of great discovery and exploration, but the development of American history was a process that took place over the centuries. The development of American history was a process that took place over the centuries. The early years of American history were a time of great discovery and exploration, but the development of American history was a process that took place over the centuries. The development of American history was a process that took place over the centuries. The early years of American history were a time of great discovery and exploration, but the development of American history was a process that took place over the centuries.



peak at thirty-six days, characterized by great follicular stimulation and some thecal and interstitial luteinization, but no formation of corpora lutea (Ortiz, 1947). Peczenick (1942b) made the same observations, except that he found massive corpora lutea, in addition. The microscopic structure of the ovaries are not affected by androgens (Ortiz, 1947 and Bruner and Witschi, 1946). Estradiol benzoate was found to have no effect on ovarian weight (Ortiz).

The reactivity of the oviducts and uterus to gonadotrophins begins at ten days, decreasing after sixteen days (Ortiz). Bruner and Witschi found that androgens have no effect on the oviducts or uterus, but Ortiz found that testosterone propionate had an inhibitory effect up to sixteen days, with no effect after that. The latter investigator also found that estradiol benzoate exerted its greatest stimulating effect at six and ten days, with no effect after that day. Ortiz also observed that the vagina opened precociously at six days, after the injection of estradiol benzoate.

Gonadotrophins stimulated the growth of the testes at all ages (Ortiz, 1947). They also increased the production of sex hormones; the reactivity beginning at the tenth day, reaching its peak at the sixteenth day, and then decreasing until the thirty-sixth day. The interstitial tissue was slightly increased by gonadotrophins, at twenty-six and thirty-six days.



Testosterone propionate has a slight inhibitory action at younger ages, the peak of reactivity being at twenty-six days of age. Estradiol benzoate slightly reduces the weight of the testes and the production of the male hormone.

The ventral prostate, the seminal vesicles, and the coagulating glands are stimulated by gonadotrophins and androgens, the peak of reactivity being reached at sixteen days of age. These hormones also produce light areas in the seminal vesicles at sixteen days. Estradiol benzoate inhibits the growth of the ventral prostate, the seminal vesicles, and the coagulating gland at some ages.

### Discussion

The work of Ortiz shows that the hamster does not continue the rapid prenatal growth in postnatal life, except in early maturation of the ovary, the establishment of estrous cycles, and the extremely precocious opening of the vagina. It also shows that the reproductive system of the hamster is less reactive to hormones than that of the rat.

The dependency of hormonal effect upon the receptivity of the end organ is especially brought out by Ortiz's report. It also points out many problems, which have not yet been answered. For example, why is the height of reactivity of the male organs reached at sixteen days? The fact that the ovaries and the female accessory organs displayed different ages, at which





they were most reactive to hormones, is also unexplained. Perhaps, the investigations described above can serve as a starting point for further investigation of the problem.

It seems that the investigation of Ortiz was carefully and accurately done, as the findings are confirmed by other workers, namely, Peczenick and Bruner and Witschi. This is one of the few instances that work on the golden hamster is confirmed by other investigators.



## ESTROUS CYCLE OF THE GOLDEN HAMSTER

The estrous cycle of the golden hamster has been studied by many investigators, the first being Deanesly (1938), and the latest Ward (1946). Deanesly established the duration of the estrus cycle at four days, but stated that the stages can not be determined by vaginal smears. Yet, she said that a sticky opaque substance can be squeezed from the vagina every fourth morning, and called it the post-estrous stage. Later investigators agreed with the finding that the duration of the cycle is four days, but observed that the stages can be determined by vaginal smears.

There has been much disagreement among the workers in the field as to the terminology, description of the histological findings, and the assignment of the vaginal smears to their proper place in the cycle. In my opinion Ward (1946), has presented the most accurate description yet available. She has studied the cycle by external inspection, examination of vaginal smears, histological sections, and mating studies.

In agreement with the terminology used for other animals, the day on which vulval discharge occurs is designated as day two and the day preceding it as day one. Ward's observations are presented in Table I.

Ward's description of proestrus agrees with that of Kent and Mixner (1945), Kent and Smith (1945), and of Kupperman, Greenblatt and Hair (1944), if their "cornified cells" are the





TABLE I

<u>Stage</u>	<u>Time</u>	<u>Characterization</u>
Stage 1 Proestrus	3 P.M. of day 1 to 6 P.M. of day 1.	Vaginal smears characterized by large numbers of non-nucleated epithelial cells, large and scale like in appearance, smaller number of nucleated epithelial cells and no leucocytes. (Fig. 1)
Stage 2 Estrus	6 P.M. of day 1 to 9 A.M. of day 2.	Vaginal smear characterized by the gradual appearance of many nucleated epithelial cells-columnar, elongated and oval. Many are vacuolated. A few large non-nucleated cells are present. (Fig. 2,3,4) Externally the last few hours of this stage are characterized by a sticky, white discharge from the vagina.
Stage 3 Metestrus A	9 A.M. of day 2 to noon of day 3.	Vaginal smear characterized by a gradual invasion of leucocytes, which reach their greatest numbers in the morning of day 3, and a gradual decrease in epithelial cells; oval epithelial cells are the predominant epithelial type present. The first hours of this stage may still be marked by the white vaginal discharge. (Fig. 5,6)
Stage 4 Metestrus* B	Noon of day 3 to afternoon (about 3 P.M.) of day 1.	Vaginal smears characterized by large amounts of amorphous debris, small numbers of epithelial cells (both nucleated and non-nucleated) and decreasing numbers of leucocytes. (Fig. 7)

\*Ward uses the terminology advocated by Asdell (1946) in his book, "Patterns of Mammalian Reproduction". Asdell states, "... confine the term metestrus to the time during which estrogenic activity is declining and diestrus to the period in which the activity of the corpus luteum is paramount...". Metestrus B refers to that stage of the cycle called diestrus in previous descriptions of the estrous cycle of the hamster.



same as Ward's non-nucleated cells. Sheehan and Bruner (1945) are not in agreement at all, their description being few cornified cells for proestrus.

Ward's description of estrus is essentially the same as that of Peczenick (1942), but varies considerable from that of other investigators. Sheehan and Bruner (1945) observed that the cellular picture of estrus consists of a "few scattered small epithelial cells." According to Kent and Mixner (1945) and Kent and Smith (1945), the animal is in estrus when the field exhibits no leucocytes and squamous cells alone are present.

Peczenich (1942), Sheehan and Bruner (1945), and Ward, all agree upon the histological picture for metestrus. However, Kent and Mixner (1945) describe the metestrous smear as being characterized by the presence of elongated squamous cells, almost exclusively, and lasting for four to eight hours.

Ward's description of Metestrus B, which corresponds with the diestrus of the other authors, concurs with that given by Peczenick (1942) and Kent and Smith (1945). The latter investigators, however, confine the sparse cellular picture to the last twenty-four hours of diestrus, the preceding twelve hours being characterized by large numbers of leucocytes and cuboidal cells. In addition, they make no reference to the morpous debris mentioned by both Ward and Peczenick.

Kupperman, Greenblatt and Hair (1944), described the vaginal smear of diestrus as being characterized by large

## THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and development. It begins with the first settlers who came to the continent in search of a better life. They found a land of vast resources and a people who were eager to learn from them. The settlers brought with them the knowledge and skills of their European ancestors, and they used these to build a new society. They established farms, towns, and a system of government that was based on the principles of liberty and justice for all. Over the years, the United States has grown from a small colony to a great nation. It has fought wars, won independence, and expanded its territory. It has also made great strides in science, industry, and the arts. Today, the United States is a world leader in many fields, and its influence is felt throughout the world.

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numbers of leucocytes, and Sheehan and Bruner (1945) observed a large number of cells, predominantly nucleated epithelial cells, leucocytes, and a few large cornified cells, during diestrus, thus disagreeing with the above-mentioned description.

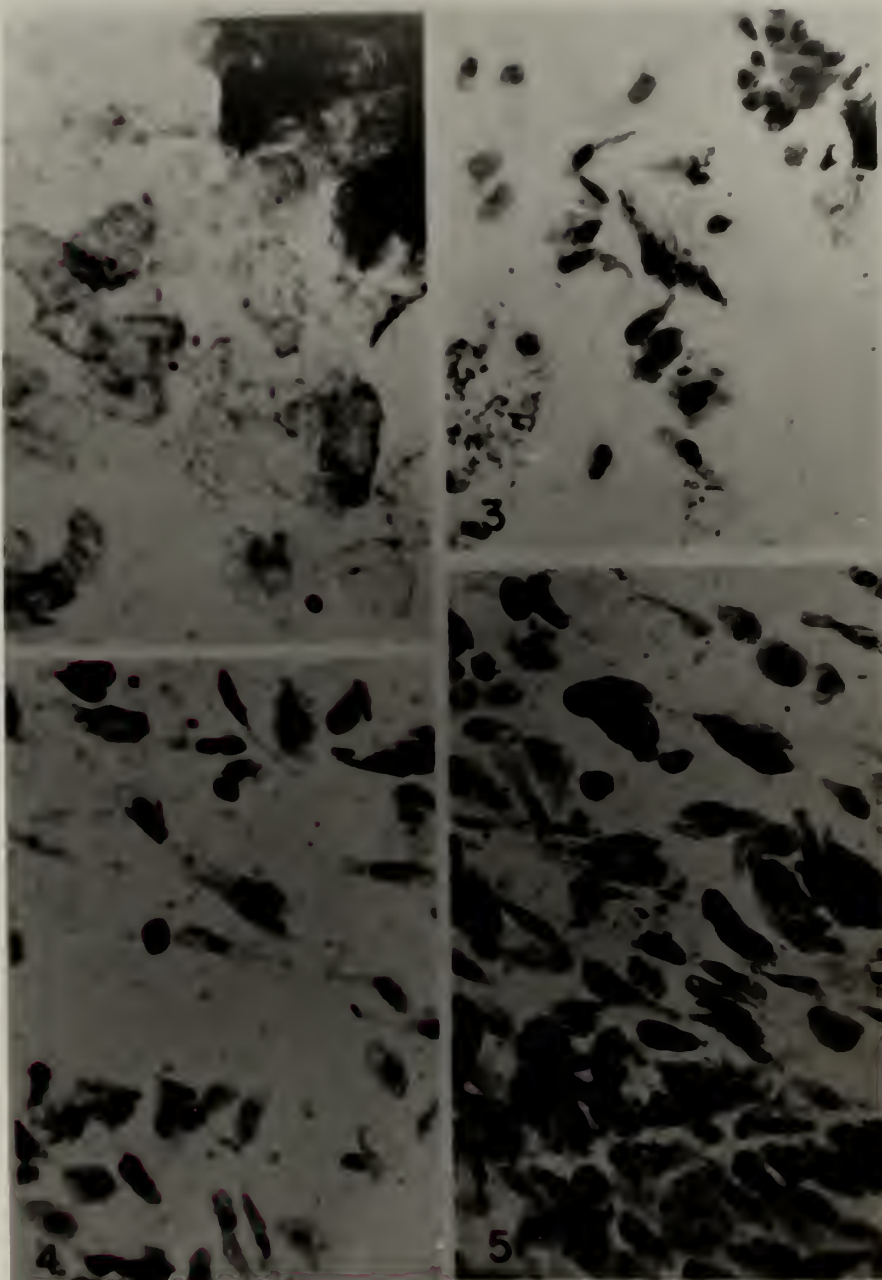


Figure 1

Proestrus Smear

Figure 2

Early Estrus Smear



Estrus Smear

Late Estrus Smear

Figure 3

Figure 4

( Magnification x320; from Ward, 1946 )

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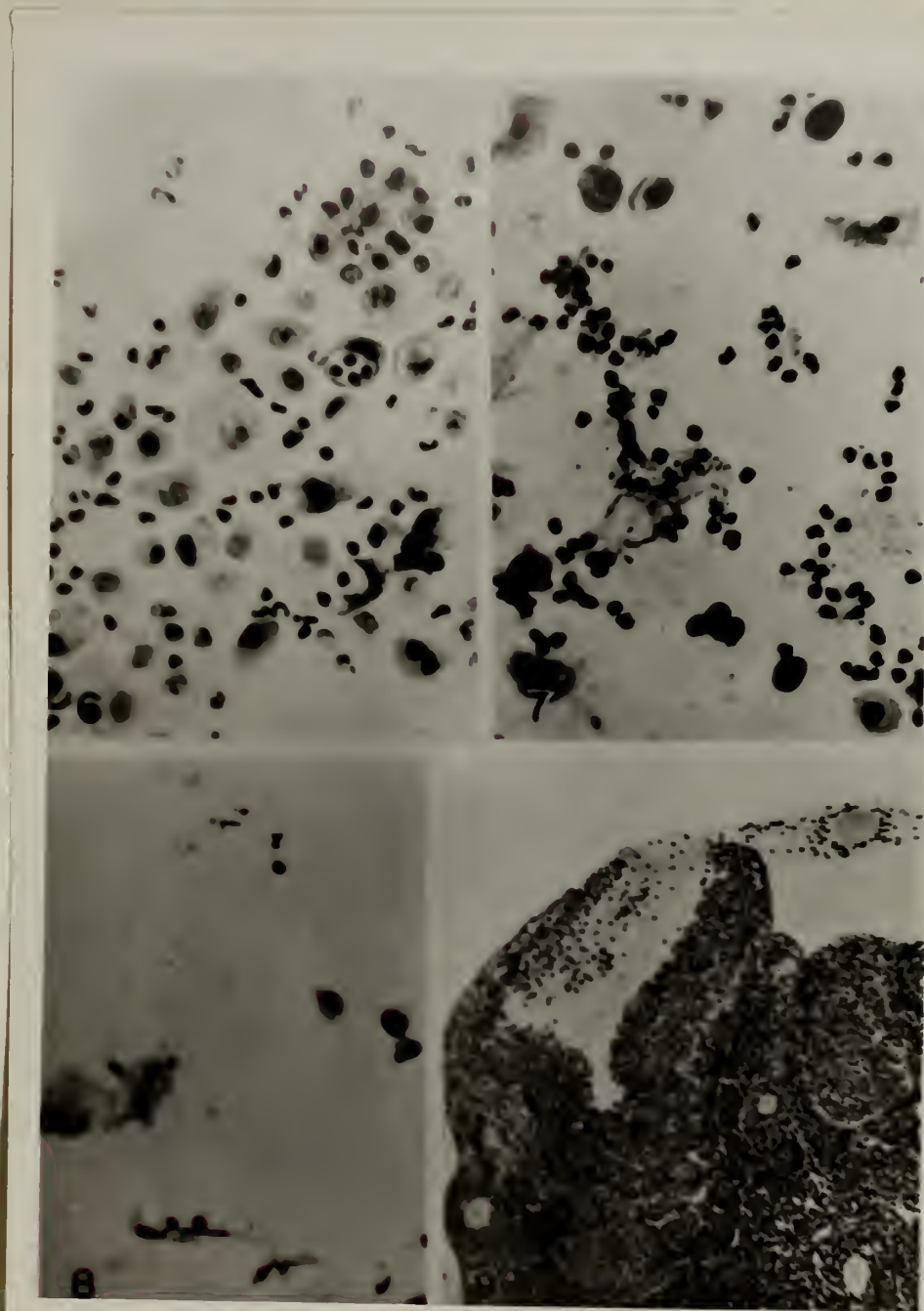
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Figure 5

Figure 6

Metestrus A

Late Metestrus A



Metestrus B

Section of Ovary At Time  
of Ovulation

Figure 7

Figure 8 (x60)

(Magnification of Fig. 5,6,7 x320; from Ward,1946)



11-11-1918

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### Time of Ovulation

In order to determine the time of ovulation, Ward (1946) killed a series of eight females in the middle of estrus, from midnight to 1:15 A.M. of day two. The ovary of one female, killed at midnight, contained six unruptured follicles in the later stages of the first maturation division. The ovary of another female killed at midnight contained one ruptured and six unruptured follicles. All the ova were in the first stages of the first maturation division.

The ovary of a female killed at 12:30 A.M. contained two ruptured follicles and five unruptured follicles. The ovary of a female killed at 12:45 A. M. contained one ruptured follicle, one follicle in the process of rupturing, and four unruptured follicles.

Three females were killed at 1:00 A.M. The ovary of the first contained two ruptured follicles, two follicles about to rupture, and two unruptured follicles; of the second, one ruptured follicle, two near ovulation, and three unruptured follicles; of the third, three follicles that had ruptured a short time previously, two more in the process of ovulation and two that had not yet ruptured. The last female of the series, killed at 1:15 A.M., possessed in one ovary, one ruptured and two unruptured follicles.

It is evident that ovulation does not occur in all the follicles at the same time. The interval between the ovu-



lation of the follicles may extend over a considerable length of time, for in some ovaries one follicle was found to have ruptured and to have undergone definite post-ovulatory changes before other follicles in the same ovary had advanced very far in preovulatory changes. From the varying conditions seen in this series, Ward suggests that ovulation may extend over a period of one to two hours, and that the peak of ovulatory activity occurs approximately at 1:00 A.M. of day two, when the vaginal smear is rich in cells and the vagina displays a flocculent moisture. These findings substantiate the observations reported by Graves (1945).

All the animals killed on the morning of day two showed about the same extent of development of the corpora lutea, and the ovaries were in a more advanced stage than that seen in the ovulating animal. This indicates that ovulation is completed in a relatively short time.

### Discussion

As can be seen from the survey of the literature on the estrous cycle of the hamster, there are a great many differences among descriptions given by different investigators. The major difficulty seems to be the difference in the various terminologies employed. This is indeed regrettable in a field of scientific inquiry, in which there must be a common language in order to advance our knowledge of that field.

Kent and Mixner (1945) describe metestrus as the





few hours when matings may prove fertile. If this is true, how can they possibly call this stage metestrus? There are other confusing differences in terminology. Are the "squamous cells" of Kent and Mixner (1945), and Kent and Smith (1945), the "cornified cells" of Kupperman, Greenblatt and Hair (1944), and the "epithelial cells" of Peczenick (1942) and Ward (1946) identical? Since there is an absence of photographs or camera lucida drawings, a clear definition of terms is essential. Ward (1946), who decries the confusion in terminology, contributes to it by introducing a new term, metestrus B. The benefit accrued from this change of the commonly used "diestrus" to metestrus B is not perceived by the author of this thesis.

Kent and Smith (1945) describe histological structures similar to those described by Ward (1946), but interpret differently the time relation in the cycle. The former investigators state that estrus lasts twenty-seven hours, while Ward states that it lasts fourteen hours. They designate as metestrus that stage which Ward interprets as middle and late estrus, because she obtained fertile matings at this time and because ovulation occurred during this interval. Since Kent and Mixner do not include the late estrous period in their estrous stage, it must be assumed that they have included in the estrous stage that which Ward describes as proestrus as well as a part of metestrus B.

Inasmuch as Ward obtained fertile matings as early as 6:00 P.M. of day one and as late as 9:30 A.M. of day two,



the intervening time must be considered the estrous period. The persistence of the estrous period into the morning characterized by mucous discharge from the vagina is a new finding. It is understood, of course, that there are individual variations in the timing of the cycle within the species pattern.

The fact that Ward found unusually small numbers of embryos in animals mated at 9:00 A.M. or after, and killed after the sixth or seventh day of pregnancy, may indicate that this elapsed time from ovulation, is approaching the life span of the egg. If the average ovulation time is at 1:00 A.M. of day two and matings may be fertile until at least 9:00 A.M., the life span of the egg must be at least eight hours, to which the time it takes the sperm to reach the egg must be added.

I feel that Ward's observations were the most accurate because she studied the cycles for the longest period of time, namely three years. In addition, she took smears at very frequent intervals, of twelve hours at the most and oftentimes every hour. The length of time which she assigns to the estrous period is corroborated by her mating experiments. The time relation of the various stages of the cycle were worked out by vaginal smears and also by studying serial sections of the ovaries, tubes and uteri from animals killed during each part of the cycle.

Perhaps most of her findings would be confirmed by the work of the other investigators in the field, if a common terminology could be worked out.





## ACTION OF SEX HORMONES ON THE ESTROUS CYCLE

In the absence of any confirmatory work, I herein present the results obtained by Peczenick (1942) quite completely. He regularly observed the vaginal smears and the shape of the ovaries and uteri of his stock of female hamsters, distinguishing four groups:

Group	I	II	III	IV
No.	27	10	29	10
Age(months)		5-15	7-21	3½-23
Cycles	regular 4 day	irregular 2-6 day	regular 4 day	---
No. Fertile	27	4(younger than 10 months)	0	0
No. Sterile	0	2(6 months old) 4(10½-16 months old)	29	10

Ten animals were given single injections of one, two, or forty micrograms of stilboestrol, and five animals were given injections of one or two micrograms of estradiol benzoate. All the animals belonged to groups I and III aged up to fourteen months. In two hamsters, one injected with one microgram of stilboestrol and the other with forty micrograms, the estrous cycle was unaffected. Estrous smears appeared in all the other individuals within forty to forty-eight hours after the injection. Those injected with doses of one or two micrograms of either substance exhibited characteristic estrous smears for less than twenty-four hours. While in the hamsters injected with forty micrograms of stilboestrol, these smears



The first part of the paper is devoted to a study of the  
 properties of the function  $f(x)$  defined by the equation  

$$f(x) = \int_0^x \frac{1}{1+t^2} dt$$
 and to the proof of the following theorem:

$f(0)$	$f(1)$	$f(2)$	$f(3)$	$f(4)$
$0$	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	$\pi$
$f(5)$	$f(6)$	$f(7)$	$f(8)$	$f(9)$
$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	$\frac{5\pi}{2}$	$\frac{9\pi}{4}$

In the second part of the paper we shall study the  
 properties of the function  $g(x)$  defined by the equation  

$$g(x) = \int_0^x \frac{1}{1+t^4} dt$$
 and to the proof of the following theorem:

The function  $g(x)$  is a strictly increasing function of  $x$  and  
 it satisfies the following inequalities:

$$\frac{\pi}{4} < g(x) < \frac{\pi}{2}$$

for all values of  $x$  such that  $0 < x < \infty$ .

persisted for two to five days.

Three females from group III, aged ten to fourteen months, were mated, two to four weeks after injection of forty micrograms of stilboestrol, with the same males that had failed to fertilize them before injection. Two of them produced litters while the third remained sterile.

Peczenick then injected in a single dose, four females of group IV, aged three-and-a-half to twenty-two months, with forty micrograms of stilboestrol. Estrous smears were provoked, which began, on an average, forty hours after the injection and persisted for three days. In the animals aged eleven and nineteen months, regular cycles were established seven and nine days, respectively, after the end of the period of provoked estrus. Eighteen days after the injection the animals were successfully mated, but the litters died within two to four days. The effect concluded with three regular four day cycles in the female aged twenty-two months, while in the one aged three-and-a-half months a spontaneous estrus occurred eleven days after the expiration of the reaction, but did not recur.

#### Large Doses

Three groups, each of five animals, (ten from group III and five virgin females) were injected daily with two hundred micrograms of stilboestrol, estrone, and estradiol benzoate, respectively, for six consecutive days. Peczenick



found that the three estrogens produced, in all the animals, a characteristic alternation of periods of estrous smears with leucocyte smears. The epithelial periods persisted for one to seven days after estradiol benzoate, one to ten days after stilboestrol, and two to six days after estrone. The leucocyte period lasted up to four days. Reaction of the estrogens began, on an average, forty hours after the first injection and lasted, in animals injected with estradiol benzoate for twenty-five to twenty-six days, in those injected with stilboestrol, nine to nineteen days, and with estrone ten to twelve days.

Females, ovariectomized either before or after puberty, and injected with two hundred micrograms of estradiol benzoate or estrone for six consecutive days, exhibited different smears from those of normal females receiving the same dose. After forty hours epithelial smears appeared; subsequently, the epithelial cells disappeared almost completely, and the smears contained mainly slightly acidophil, basophil or pale cornified scales. These cornified smears alternated at irregular intervals with leucocyte smears. Shortly before the expiration of the reaction the number of cornified scales decreased and the number of epithelial cells again increased. Spontaneous estrus occurred as early as three to eight days after the last provoked estrous smears, and were followed by regular four day cycles. The animals were mated eight to twenty-four days after the disappearance of the estrogenic effect, but they remained sterile.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1801. It contains a report on the state of the Union and the administration of the government during the first year of the new administration. The President mentions the death of George Washington and the inauguration of himself as the first President of the United States. He also mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 3, 1801. It contains a report on the state of the Treasury and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

3. The third part of the document is a report from the Secretary of the Navy, dated January 3, 1801. It contains a report on the state of the Navy and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

4. The fourth part of the document is a report from the Secretary of the War, dated January 3, 1801. It contains a report on the state of the War and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

5. The fifth part of the document is a report from the Secretary of the State, dated January 3, 1801. It contains a report on the state of the State and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

6. The sixth part of the document is a report from the Secretary of the War, dated January 3, 1801. It contains a report on the state of the War and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

7. The seventh part of the document is a report from the Secretary of the Navy, dated January 3, 1801. It contains a report on the state of the Navy and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

8. The eighth part of the document is a report from the Secretary of the Treasury, dated January 3, 1801. It contains a report on the state of the Treasury and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

9. The ninth part of the document is a report from the Secretary of the State, dated January 3, 1801. It contains a report on the state of the State and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.

10. The tenth part of the document is a report from the Secretary of the War, dated January 3, 1801. It contains a report on the state of the War and the administration of the government during the first year of the new administration. The Secretary mentions the signing of the Treaty of Tripoli and the establishment of the Department of the Interior.



### Action of Gonadotrophic Extracts

Four milligrams of AP118B (mixed horse anterior pituitary extract) produced in twenty-four-day-old hamsters estrous smears, ripe follicles, and luteinization; but in those eighteen days old, estrous smears without ripe follicles. Eighty micrograms of chorionic gonadotrophin produced estrous smears in twenty-four-day-old but not in eighteen-day-old females; while a dose of one hundred-sixty micrograms was effective in both groups. The estrous smears began ninety-six hours after injection and disappeared in less than twenty-four hours.

Five twenty-four-day-old females received four milligrams of AP118B daily for twelve days; five more of the same age received thirteen-hundred-twenty micrograms of chorionic gonadotrophin daily. Ninety-six hours after the first injection, estrous smears appeared. After seven to ten days the estrous smears changed their character and then consisted of a thin, slimy fluid, and could no longer be fixed by Leishmann's method. Ehrlich's haematoxylin was then used as the stain after fixing in methyl alcohol. Very small round cells, cell debris and scattered nuclei were seen, as well as columnar epithelial cells with small nuclei.

The smears contained most of these cells nine to thirteen days after the first injection. After this, the secretion of the thin slimy fluid increased, while the columnar



cells gradually diminished in size and number and seemed to disintegrate more readily.

#### Effect in Adult Females

Five animals from groups I and III each received single injections of eight or twenty-four international units of chorionic gonadotrophin; another five from the same groups, daily injections of two milligrams of AP 118B on three successive days. Estrus occurred, on the average, sixty-four hours after the injection of the chorionic gonadotrophin, or after the first injection of the AP118B, and lasted four days independently of the stage of the estrous cycle. In the animals treated with the former, the regular estrous cycle was resumed four to eight days after the provoked estrus had ceased; in those treated with the latter, the cycle was resumed as early as four to five days after the last injection.

One group of five adult animals received injections of two hundred international units of chorionic gonadotrophin on five consecutive days, and another similar group four milligrams of AP118B on ten consecutive days. As early as three to five days later, shortly after the onset of provoked estrus, columnar-cell smears were obtained. Columnar cells were especially numerous and well formed in the earliest smears, subsequently decreasing rapidly in number, size, and state of preservation with the increase of mucous secretion.

1870

1870

...



Among them were seen isolated, larger, plate-like epithelial cells, also small cells of the estrous epithelial type.

In five more females, which had been injected daily with five milligrams of OMAO (old mare anterior pituitary extract) on ten consecutive days, the columnar cells first appeared four to seven days after the first injection. The estrous epithelium did not seem to decrease regularly, but varied irregularly or showed an actual increase after a short period of decrease.

#### Relationship of the Uterus and Ovaries in Pregnancy

The golden hamster is a species particularly favorable for contributing evidence on the action of the uterus on the ovary during pregnancy (Klein, 1938b). Klein made the observation that the removal of the entire uterus of the pregnant female causes the rapid and premature involution of the corpus luteum, resembling the reappearance of the estrous cycle. In addition, he observed that the ablation of only the embryos affects neither the corpora lutea, nor on the estrous cycle, provided that the placenta remains inserted into the uterine wall.

#### Action of Sex Hormones in Pregnancy

When female hamsters were ovariectomized during pregnancy the characteristic mucification of the vagina rapidly disappeared (Klein, 1938a). The injection of estrogen or





of progesterone alone ailed to produce mucification of the vagina of ovariectomized animals. However, when both estrogen and progesterone were injected simultaneously the vaginal mucification was maintained. It is, therefore, apparent that the vaginal mucification is caused by the simultaneous action of the two ovarian hormones.

### Discussion

Peczenick's results (1942b) show certain peculiar results in which the golden hamster, in its reactions to sex hormones differs not only from other species but from other rodents. There is a marked difference between the effects of the same doses of estrogen on normal and ovariectomized animals. In the former, the estrogen produces a vaginal smear substantially the same as that shown in physiological estrus; it resembles the vaginal smears given by rats and mice, both in pro-estrus, and, exceptionally, in metestrus, and by ferrets (Hamilton and Gould, 1940) at the beginning of estrus. In ovariectomized animals, the estrus smears typical of hamsters were found by Peczenick only at the beginning and near the end of the reaction; the smears produced at the height of the reaction were substantially the same as estrous smears in rats and mice.

After the prolonged application of the gonadotrophic extracts a vaginal smear was produced which was different from those exhibited by other rodents, and which appears to be



a characteristic of the species. The fact that this vaginal smear was produced by progesterone and also found in pregnant animals show that it indicated the luteal phase of the vaginal mucosa. The columnar cells found in the smears are, in all probability, analogous to the mucifying cells found in the vaginal wall of mice and rats treated continuously with gonadotrophic extracts, and have been described as denoting "the second ovarian phase" (Marshall and Wiesner, 1932).

In the light of the discussion of the estrous cycle (see page 19), the question might arise as to whether Peczenick's description of estrus is accurate. Since it is in accord with Ward's finding (1946), I presume that Peczenick's histological description is correct.

The reaction of immature females to chorionic gonadotrophin demonstrate the endocrinological principle, namely, the reactivity of a tissue depends on the receptivity of the tissue and the amount of hormone involved.





## THE ADRENALS OF THE GOLDEN HAMSTER

Peczenick (1944) described the appearance of the normal male and female adrenals in the golden hamster (Figs. 9 & 10). The author found a difference in the respective weights of the adrenals that is the reverse of the relationship observed in rats and mice (Bourne and Zuckerman, 1940); (Kupperman and Greenblatt, 1947), that of the male being greater than that of the female. It was found that the medullary diameters do not differ, but that the medullary total diameter ratios are different. This implies that the greater weight of the male adrenal is attributable at least in part, to the greater size of the male cortex. The weight of the male adrenal was found to be about .02% of the total body weight and the female adrenal approximately .008% of the total body weight. This dimorphic difference begins to appear with the beginning of androgenic activity in the male, as evidenced by the appearance of pigment spots on the dorso-lateral surface of the skin, about one third the distance between the xyphoid process and the iliac crest (Kupperman and Greenblatt, 1947).

In observing the external size of the adrenals, it was found that the left adrenal is approximately one and one half times the size of the right in both the male and the female. This condition is similar to that found in rats and mice.

There has been no evidence presented that there is



an X-zone in the cortex, as has been found in young mice.

A sex-difference in the vacuolization of the cortex was also observed by Peczenick (1944). The number and distribution of these vacuoles varied with the season, and in the female, also with the age and with the stage of the estrous cycle. In animals observed before or during the breeding season the male adrenal exhibited a vacuolized zone in the outer layers of the fasciculata (see Fig. 9), whereas the cells of the broader flatter inner zone were more compact. In diestrous and estrous females the vacuoles were more widespread and extended through the entire fasciculata to the reticular zone. The vacuolization seemed to become slightly increased during estrous. During metestrous the cortex appeared thickened and the vacuolization was rather similar to that of the male adrenal.

In animals observed during October and November, the vacuolization of the cortex of both the male and the female was greatly reduced. In senile females examined in March, the reticularis and the inner layers of the fasciculata were more vacuolized than the outer layers.

A sex-difference in the vacuolization of the adrenal cortex is also found in the guinea-pig (Kolmer, 1912; Allen and Bern, 1942). In this animal sudanophilic substances are found in the vacuoles of the fasciculata, as in the case of the rat (Golla and Reiss, 1942). In the golden hamster, however, the majority of the larger vacuoles did not contain





"visible fatty substances"(Bolles Lee, 1937). In chromated fresh sections droplets were seen which, with rare exceptions, were not stained with Sudan III and in some cases not even soluble in alcohol. The distribution of the "visible fatty substances" did not correspond to that of the vacuoles.

#### Relation of Environmental Conditions to the Adrenal

In golden hamsters adapted to 25°C. there was a marked increase in the region of the medulla taking a chromaffin stain (Kayser, 1939). In animals adapted to 8°C. there was very little chromaffin reaction. Since there is a reflex secretion of adrenin in the case of chemical temperature regulation, Kayser concluded that there was a definite relationship between the adaptation to temperature and chemical regulation. This indicates that the amount of adrenin present in the medulla is scarce in the adaptation to cold.

Peczenick (1944), following the histological data from the rat (MacKay and MacKay, 1926), namely, that after unilateral adrenalectomy the hypertrophied cortex of the remaining adrenal increases in activity, studied the reaction of the vacuoles in the hamster adrenal cortex under experimental conditions that would alter the activity of the cortex.

In agreement with the findings of the effect of extreme environmental temperatures on the activity of the cortex of the rat (Flexner and Grollman, 1939), Peczenick found that when the temperature fell suddenly vacuoles were practically





absent from the cortex. Lipoid material was confined to tiny droplets in the reticularis and the adjacent layers of the fasciculata.

Upon exposure to 35°C. for a period of four weeks, vacuoles were almost or completely absent from the fasciculata. Lipoid material was absent from the fasciculata save from the innermost layer, but the glomerulosa and the reticularis were crowded with sudanophilic lipoid droplets. In addition, the juxtamedullary layer of the reticularis exhibited peculiar small cells surrounded by dilated capillaries.

#### Effect of Sex Hormones on the Adrenals

In castrated male hamsters, the adrenal cortex reacted in the same way as in males kept at a high temperature. The ratio of the adrenal weight to the total body weight also kept decreasing (Peczenick, 1944). Kupperman and Greenblatt (1947) confirmed this finding with their description of the dimorphism of the adrenals due to androgenic activity. The histological picture of the cortex of the ovariectomized female resembled that of the normal male, save that the vacuoles were small, the large vacuoles being entirely absent. Peczenick gave neither the absolute weight of the adrenal nor any quantitative measurements as to its size.

In contrast to Kupperman and Greenblatt, who claimed no specific effect of sex steroids on the adrenals; Peczenick (1944) found that vacuolization of the cortex of the male cas-

1. The first part of the paper is devoted to a general discussion of the problem of the existence of solutions of the system of equations (1) and (2) under the assumption that the functions  $f$  and  $g$  are continuous and satisfy certain conditions.

2. In the second part, we consider the case when the functions  $f$  and  $g$  are piecewise continuous and the system of equations (1) and (2) is solved in the sense of Carathéodory. It is shown that under certain conditions, the system has a unique solution.

3. In the third part, we consider the case when the functions  $f$  and  $g$  are discontinuous and the system of equations (1) and (2) is solved in the sense of Filippov. It is shown that under certain conditions, the system has a unique solution.

4. In the fourth part, we consider the case when the functions  $f$  and  $g$  are discontinuous and the system of equations (1) and (2) is solved in the sense of Filippov. It is shown that under certain conditions, the system has a unique solution.

5. In the fifth part, we consider the case when the functions  $f$  and  $g$  are discontinuous and the system of equations (1) and (2) is solved in the sense of Filippov. It is shown that under certain conditions, the system has a unique solution.

6. In the sixth part, we consider the case when the functions  $f$  and  $g$  are discontinuous and the system of equations (1) and (2) is solved in the sense of Filippov. It is shown that under certain conditions, the system has a unique solution.

7. In the seventh part, we consider the case when the functions  $f$  and  $g$  are discontinuous and the system of equations (1) and (2) is solved in the sense of Filippov. It is shown that under certain conditions, the system has a unique solution.

trate was almost completely restored to normal upon treatment with androgens. However, the reticularis retained the characteristics of castration, many sudanophilic elements and small cells surrounded by dilated capillaries.

In ovariectomized females the administration of testosterone propionate caused a further reduction of vacuolization of the cortex, or a complete absence of vacuoles. In those females ovariectomized before maturation a normal male histological picture of the cortex was found.

The administration of estrogens to castrated males produced no change, except that in two cases the vacuolization was increased and distributed as in the female type. The reticularis of the two males showed no change from the castrate condition.

The administration of estrogens provoked different effects in the female castrate and non-castrate. In the female non-castrate, the cortex was moderately hyperaemic and vacuolization was increased. In the castrates, an exaggerated hyperaemia was exhibited and the spaces filled with erythrocytes and blood pigments. The cells were solid, the columnar arrangement in the fasciculata was lost and there was no distinction between the fasciculata and the reticularis.

In aged females injected with anterior pituitary gonadotrophin, the vacuolization of the cortex was not increased. The cells were more compact and had almost no vacuoles. No increase in cell division was detectable by the

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colchicine test. In those injected with colchicine alone there was an increase of vacuolization, showing that the alkaloid did not inhibit the vacuolization of the cortex.

### Discussion

The question arises as to whether the described actions of the active substances on the cortex are hormone effects or symptoms of a non-specific alarm-reaction (Selye, 1936). It would seem that androgens have a specific hormonal effect on the adrenal, for castration of the male produces effects that can be decreased or prevented by replacement therapy.

The circumstances are more complicated in the case of the female. In ovariectomized females, the sex-difference in adrenal weight is equalized, but neither this effect nor the reaction observed histologically is at all neutralized by the administration of estrogens. The adrenals show in their response to estrogens a dependence on the ovaries similar to the vagina (Peczenick, 1942). It is possible that in non-castrates the large doses of estrogens may be so weakened in their action on the adrenal cortex that, even as a nociferous stimulus, they may lead to an increased activity of the cortex, but never to exhaustion. Therefore, an increase in the vacuolization in non-castrated females treated with estrogens does not prove the hormonal nature of the effect. On the other hand, the possibility of converting the type of vacuolization may indicate a



specific hormonal effect of the estrogen.

Another problem is raised by the work of Peczenick (1944), namely, what is the function of the vacuoles? His description of the distribution of the vacuoles, as a great many in the outer layers of the fasciculata, decreasing in number in the inner layers, and none in the glomerulosa, is similar to Deane and Greep's (1946) description of the distribution of sudanophilic lipoid in the cortex of the rat. However, Peczenick found little or no sudanophilic material in these vacuoles, but rather tiny droplets of lipoid distributed through the cortex, in the same manner as that of the rat (Deane and Greep, 1946).

Peczenick fails to indicate what substance, if any, is secreted in the vacuoles. Yet, according to his results, the number and distribution of the vacuoles is an indication of the activity of the adrenal cortex. His statement, that in "cold animals" the vacuolization of the cortex is markedly reduced, seems to indicate that the greater the amount of vacuolization the greater is the activity of the adrenal.

Moreover, Peczenick (1944) observed that in "cold animals" the sudanophilic droplets were confined to tiny droplets in the reticularis and the adjacent layers of the fasciculata, which is in accord with the results obtained by Greep and Deane (1946). Therefore, it seems as if the vacuoles of the adrenal cortex of the hamster react in the same way as





does lipoid material. The vacuoles can not contain cholesterol as that substance is stained with Sudan III. Perhaps, the cortical hormone itself or one of its constituents, that is not sudanophilic, is stored there.

Assuming that Peczenick's technique for the staining of lipoids was accurate, further work should be done to determine exactly what is in the vacuoles of the adrenal cortex of the hamster.





## MALE TYPE OF ADRENAL VACUOLIZATION

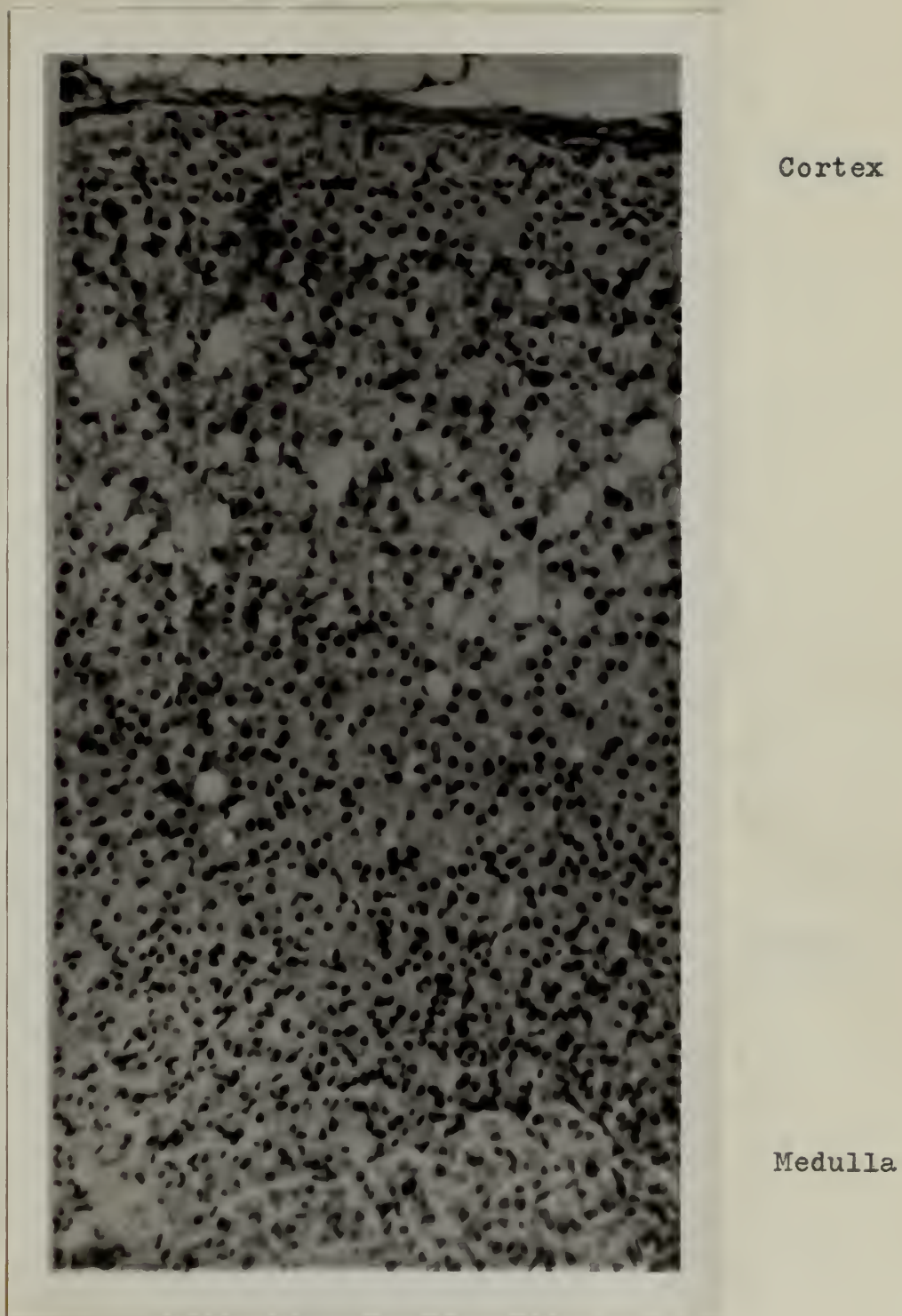


Figure 9

(Magnification about x440; from Peczenick, 1944)



## FEMALE TYPE OF ADRENAL VACUOLIZATION



Figure 10

(Magnification about x440; from Peczenick, 1944)

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1900



## BILATERAL ADRENALECTOMY OF THE HAMSTER

## Introduction

There are several reasons why a series of bilateral adrenalectomies were undertaken in the golden hamster. First, the hope that this investigation would add to our present limited knowledge of the endocrinology of the species. Second, since the hamster is especially suited for laboratory investigation, a successful operative technique would offer a convenient method of studying the functions and reactions of the mammalian adrenals. As an example, the hamster would be a convenient laboratory animal for the study of the relationship between the adrenals and growth processes, because the animal reaches maturity in such a short time. Third, the investigation has value as a necessary preliminary to the study of transplantation of the adrenals. The study of the degeneration and regeneration of the adrenal tissue would be of particular value at the present time, in order to provide further evidence for or against Deane and Greep's (1946) suggestion that Zwemer's "Escalator Theory" of the growth of adrenal cortical cells is inaccurate.

Peczenick, 1944, performed unilateral adrenalectomies on the hamster, in the course of his investigation into the action of sex hormones on the adrenal cortex; however, he did not describe his operative technique.

# THE HISTORY OF THE

REIGN OF

CHARLES THE FIRST  
BY  
JOHN BURNET  
OF LINCOLN'S INN  
ESQ.  
IN TWO VOLUMES.  
LONDON, Printed by J. Streater, at the Sign of the Gun, in St. Dunstons Church-yard, 1679.

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An operative technique for adrenalectomy of the hamster will be presented, in the body of this paper. A preliminary report on the physiological effects of bilateral adrenalectomy in the golden hamster will also be presented.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1801. It is a very important document, as it is the first time that the President has addressed the Congress since the establishment of the office. The letter is written in a very formal and dignified style, and it contains many important points. The President discusses the state of the Union, the progress of the government, and the future of the country. He also mentions the recent election of Thomas Jefferson as President, and he expresses his confidence in the new administration. The letter is a masterpiece of political writing, and it is one of the most important documents in American history.

## Method

### Operative Technique

The first technique attempted was a dorsal approach used by Dr. Wyman and Dr. tum Suden at the Boston University School of Medicine and by others in the rat. This technique consisted of puncturing, with sharp forceps, the dorsal muscle wall over the site of the adrenal; spreading the muscle fibers with the forceps, and removing the adrenal. This did not prove feasible because of the extreme delicacy of the hamster's abdominal wall and the position of the liver. It was found that the puncture could not be controlled well enough to avoid lesion of the liver, resulting in a severe hemorrhage, which obscured the entire field.

A ventral approach also proved unusable for it entailed too much manipulation of the gastro-intestinal tract and too much exposure of the abdominal cavity, resulting in fatal shock. The technique finally found successful is herein presented, step by step.

Ether was used as the anesthetic. A bell jar, covered with a glass plate, was utilized for the anesthetizing chamber, while a wire-gauze cone provided a continuous ether-air mixture throughout the operation. In order to immobilize the animal and to provide a maneuverable tabel, a frog board and clips were employed. Although the instruments were sterilized and a tincture of iodine applied to the operative field,





an absolutely aseptic technique was not used. Figure 11 demonstrates the pre-operative set-up.

The hamster was placed in the ether chamber for a period of two to four minutes (Fig. 12). When the animal became limp and began to breathe very rapidly, it was removed from the chamber, placed on the frog board, and secured and the ether cone was placed over the nostrils (Fig. 13). Care must be taken in anesthetizing the hamster, for it was found that the margin between anesthetization and death was very narrow.

The hair on the operative field, which extends from the first lumbar vertebra to two-thirds the distance to the sacrum, was then clipped and a tincture of iodine applied to the area. A skin incision of three-and-a-half to four centimeters was made; and the skin was then freed from the abdominal muscles by separating the subcutaneous fascia (Fig. 14).

The field then exposed is as follows (Fig. 14): the anterior border of the field is at the level of the first lumbar vertebra, while the posterior border is approximately one-half the distance to the sacrum. Exposed by the incision are the *Musculus latissimus dorsi*, the *Musculus obliquus abdominis externus*, and the anterior end of the lumbodorsal fascia. Landmarks are subcutaneous blood vessels, in the region of the angle of the eleventh rib and the vertebral column, and abdominal fat extending posteriorly from the angle out of the field (Drawing 1).

Figure 14

An incision was then made five to ten millimeters

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from the apex of the angle, immediately above the abdominal fat, and between the blood vessels. This was done by snipping the muscle wall with sharp scissors. Care must be taken not to injure the intestinal tract, which often lies close to the area of incision. The incision is then expanded by extension of a pair of forceps, in a direction which is at right angles to the direction of the muscle fibers (Fig. 15). The incision was then held open by moderately curved forceps, exposing the kidney, the upper pole of which is overlapped by the liver (Fig. 15). The position of the adrenal in relation to the kidney is shown in Figure 16.

In order to bring the right adrenal into the field, curved forceps were placed under the upper pole of the kidney, which was then rotated upward (Fig. 17). The adrenal was surrounded by a small ring of fatty tissue and adhered closely to the kidney. Extreme care had to be used in removing the adrenal. The adrenal peduncle was clamped with curved forceps. Then the forceps holding the incision open were released, but allowed to remain in the incision, acting as retracters. With other forceps, the adrenal was worked free. Hemostasis took place quickly so that ligation was not necessary. The procedure for the removal of the left adrenal was the same, except that the adrenal can be seen without rolling the kidney.

The muscle incision may be left unsutured, unless over one centimeter in length. If sutures were employed, number 000 surgical silk was used (Fig. 18). Finally, the







skin incision was sutured with number 00 surgical silk. (Fig.19)

#### Experimental Procedure

Nine operated animals were placed on Rockland Mouse Diet and tap water. Eight operated animals were placed on saline solution (0.5% sodium citrate and 0.5% sodium chloride and Rockland Mouse Diet. Five other animals were blank operated and placed on tap water and Rockland Mouse Diet. Five unoperated animals were used as controls and were placed on tap water and Rockland Mouse Diet.

The body weights and food intake of all the animals were recorded daily. Autopsies were performed upon death of any of the animals.

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## PHYSICS 341

LECTURE 10: THE HARMONIC OSCILLATOR

The harmonic oscillator is a fundamental model in physics. It describes a particle of mass  $m$  attached to a spring with spring constant  $k$ . The potential energy is given by  $V(x) = \frac{1}{2}kx^2$ . The equation of motion is  $m\ddot{x} = -kx$ , which has the solution  $x(t) = A\cos(\omega t + \phi)$ , where  $\omega = \sqrt{k/m}$  is the angular frequency,  $A$  is the amplitude, and  $\phi$  is the phase constant.

The energy of the oscillator is the sum of kinetic and potential energy:  $E = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}kx^2$ . For a given energy  $E$ , the motion is periodic with period  $T = 2\pi/\omega$ .

END OF LECTURE

## Results

### Operative Results

Bilateral adrenalectomies were attempted on twenty-one hamsters, with seventeen of these surviving. Therefore, of the deaths occurred in the first operative series, which consisted of nine animals; while only one animal died during the operation, in the second series, which consisted of twelve animals.

The cause of death, in all cases, was asphyxiation, due to blocking of nasal passages. It seemed that too long exposure to the anesthesia in the ether chamber caused excess formation of mucous. The animal breathed sharply and noisely immediately prior to the cessation of respiration, which stopped suddenly.

Perhaps, it would have been better to use urethane as the anesthesia. Dr. Fulton of the Boston University Biology Department successfully used urethane, in the case of the hamster, in the course of his work upon the circulation of the cheek pouch. However, one serious disadvantage in the use of urethane is that two people are needed to administer it. Therefore, if one is working alone, ether remains as the preferable anesthesia, with great care being used in its administration.



## Physiological Results

### Animals Placed on Tap Water

Of the nine animals placed on tap water and Rockland Mouse Diet, three died between the fifth and eighth days after the operation. Operative injury to the right lobe of the liver and the right kidney appeared to have caused the death of the animal that died on the eighth post-operative day (Chart 1).

Autopsy of the animal that died on the sixth post-operative day revealed no apparent adrenal insufficiency. The left lobe of the liver was slightly congested, marking the site of a possible operative injury. The cause of death was undetermined (Chart 2).

Adrenal insufficiency did not appear to be the cause of death of the animal that died on the fifth post-operative day. Upon autopsy the outer muscle layers of the stomach and duodenum were seen to be ulcerated, with an actual perforation in the stomach wall (Chart 3).

The six remaining animals have maintained their body weight fairly well (Graph 1; charts 4, 5, 6, 7, 8, 9). All are living, at the present time, with the exception of one animal sacrificed on the twenty-seventh post-operative day, in order to check the thoroughness of the operation. There was no macroscopic evidence of adrenal tissue remaining. At this writing, two of the group have survived for thirty days, one for



THE  
JOURNAL OF THE  
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twenty-four days, and two for nineteen days.

#### Animals Placed on Saline Solution

Two of the animals placed on saline solution died within five days after the operation. There was no evidence of adrenal insufficiency, but the lungs were markedly congested upon autopsy. Therefore, it seems as if an after-effect of the anesthesia was the cause of death (Chart 10).

One of the animals of the group died on the fourteenth day after the operation. Post-mortem examination revealed that the body fat had disappeared, with no other apparent signs of adrenal insufficiency (Chart 11).

Another animal of the group died on the eighth post-operative day. There were no evident signs of adrenal insufficiency upon autopsy. However, the intestines were perforated in two places. This could account for the weight loss of the animal (Chart 12).

Three animals of the group are still alive at the fifteenth post-operative day. Their weight loss has been very slight, with their weight curve remaining fairly steady (Graph 2; charts 13, 14, 15). Saline solution seems to have no effect on body weight. The weight curves of animals placed on saline are similar to the weight curves of the animals placed on tap water.

## THE HISTORY OF THE

REIGN OF KING CHARLES THE FIRST

IN WHICH ARE CONTAINED THE MOST IMPORTANT  
EVENTS OF HIS REIGN

FROM THE BEGINNING OF HIS REIGN  
UNTIL HIS DEATH

BY JOHN BURNET  
OF THE UNIVERSITY OF OXFORD

LONDON: Printed by J. Streater, at the  
Sign of the Gun, in St. Dunstons Church-yard, 1680.

IN TWO VOLUMES.  
THE FIRST.

THE SECOND.

THE THIRD.

THE FOURTH.

THE FIFTH.

THE SIXTH.

### Blank Operated Animals

All the blank operated animals survived, except one that died from an undetermined cause. Their body weight has decreased from three to ten grams, while the individual animal shows a fairly constant weight curve (Graph 3; chart 16).

### Normal Controls

One of the normal controls died on the ninth day after the beginning of the experiment from an undetermined cause. The four remaining animals are still living. The body weight of all the animals has increased or remained the same since the inception of the experiment (Graph 4; chart 17). No correlation could be made between food intake and body weight of any of the animals of all the groups.

### Discussion

It is felt by this writer that a practical operative procedure for bilateral adrenalectomy of the hamster has been presented. That a few animals were lost because of overdose of anesthesia or because of operative injury is to be expected, for the investigator was unfamiliar with the technique. With added experience it is probable that close to one hundred percent success will be achieved.

The physiological results observed are most interesting, for they are contrary to our previous knowledge of the

## Introduction

The purpose of this study is to investigate the effects of the proposed system on the performance of the system. The study is divided into two main parts: a theoretical analysis and an experimental evaluation. The theoretical analysis is based on the principles of the system and the experimental evaluation is based on the results of the experiments.

## Methodology

The methodology of this study is based on the principles of the system and the experimental evaluation. The theoretical analysis is based on the principles of the system and the experimental evaluation is based on the results of the experiments. The study is divided into two main parts: a theoretical analysis and an experimental evaluation. The theoretical analysis is based on the principles of the system and the experimental evaluation is based on the results of the experiments.

## Results

The results of the study show that the proposed system has a significant effect on the performance of the system. The theoretical analysis shows that the system is capable of handling a large number of requests and the experimental evaluation shows that the system is capable of handling a large number of requests. The study is divided into two main parts: a theoretical analysis and an experimental evaluation. The theoretical analysis is based on the principles of the system and the experimental evaluation is based on the results of the experiments.

The study is divided into two main parts: a theoretical analysis and an experimental evaluation. The theoretical analysis is based on the principles of the system and the experimental evaluation is based on the results of the experiments.



function of the adrenal cortex. The golden hamster is the only species, thus far studied by endocrinologists, able to withstand and survive bilateral adrenalectomy, without administration of cortical hormones or salts.

Before going any further, it must be emphasized that these are tentative and preliminary results. The adrenalectomized animals must be followed for a much longer post-operative period and many more animals must be tested before any validity can be attributed to the results.

Some adrenal cortical tissue might have been left after the operation and might have regenerated, enabling the animals to survive. However, the fact that six animals have survived and maintained their body weights at a fairly constant level, and that a check exploration failed to reveal any regenerated tissue seems to indicate there is some other mechanism of compensation for the loss of the adrenals.

The first possibility that presents itself is that of microscopic rests of adrenal cortical tissue within the peritoneal cavity, sufficient for the survival of the animal. This is the line of investigation upon which this investigator is now working. In addition, I intend to perform additional series of adrenalectomies to check my results.

There ought to be fairly large amounts of this microscopic tissue, if any, for the weight loss of the adrenalectomized animals seem to coincide with the weight loss of the blank operated animals. In order to further control the con-



ditions of the investigation, litter mates should be used for comparison. This was not done in the present investigation.

If no accessory adrenal cortical tissue is found, the number of possible compensating mechanisms is very large, requiring much further investigation.

The above discussion is based on the belief that the investigation, as far as it has gone, is accurate. I hope, that it has, at least, pointed out the problem that is raised by the results of the study of the effect of bilateral adrenalectomy of the hamster.

#### Summary

1. A practical procedure for bilateral adrenalectomy of the golden hamster is described.

2. The possibility that golden hamsters are able to survive bilateral adrenalectomy, without administration of cortical hormone or electrolytic salts, is presented.





### SUGGESTED PROBLEMS FOR FURTHER RESEARCH

1. The relation between the hormonal effect and the age of the end organ. The short gestation period and the short time needed for maturity makes the hamster especially well suited for this investigation.

2. The function of Peczenick's vacuoles of the adrenal cortex.

3. The physiological effect of bilateral adrenalectomy in the hamster is now being investigated in the Boston University Biology Laboratories and offers many possibilities for research.

4. The morphology and histology of the pituitary, the thyroid, the pancreas, the testes, the ovaries, and uterus have not been adequately or accurately described, as yet.

5. It would be of interest to make histological studies of the endocrine organs throughout the life span and also at different times of the year.

6. Since the hamster seems to differ in many ways from other species, it might be of some value to investigate the functions of all the endocrine organs.



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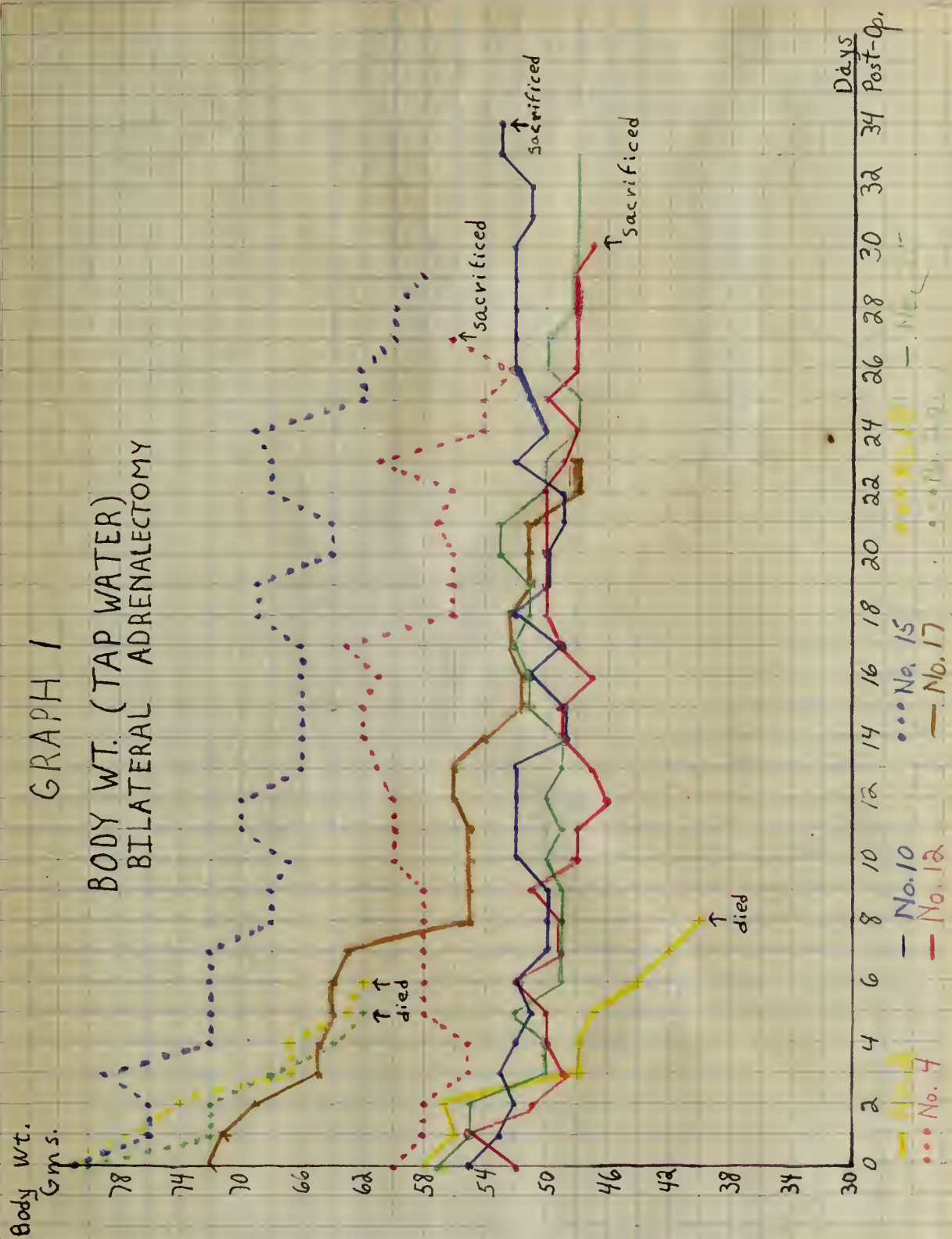
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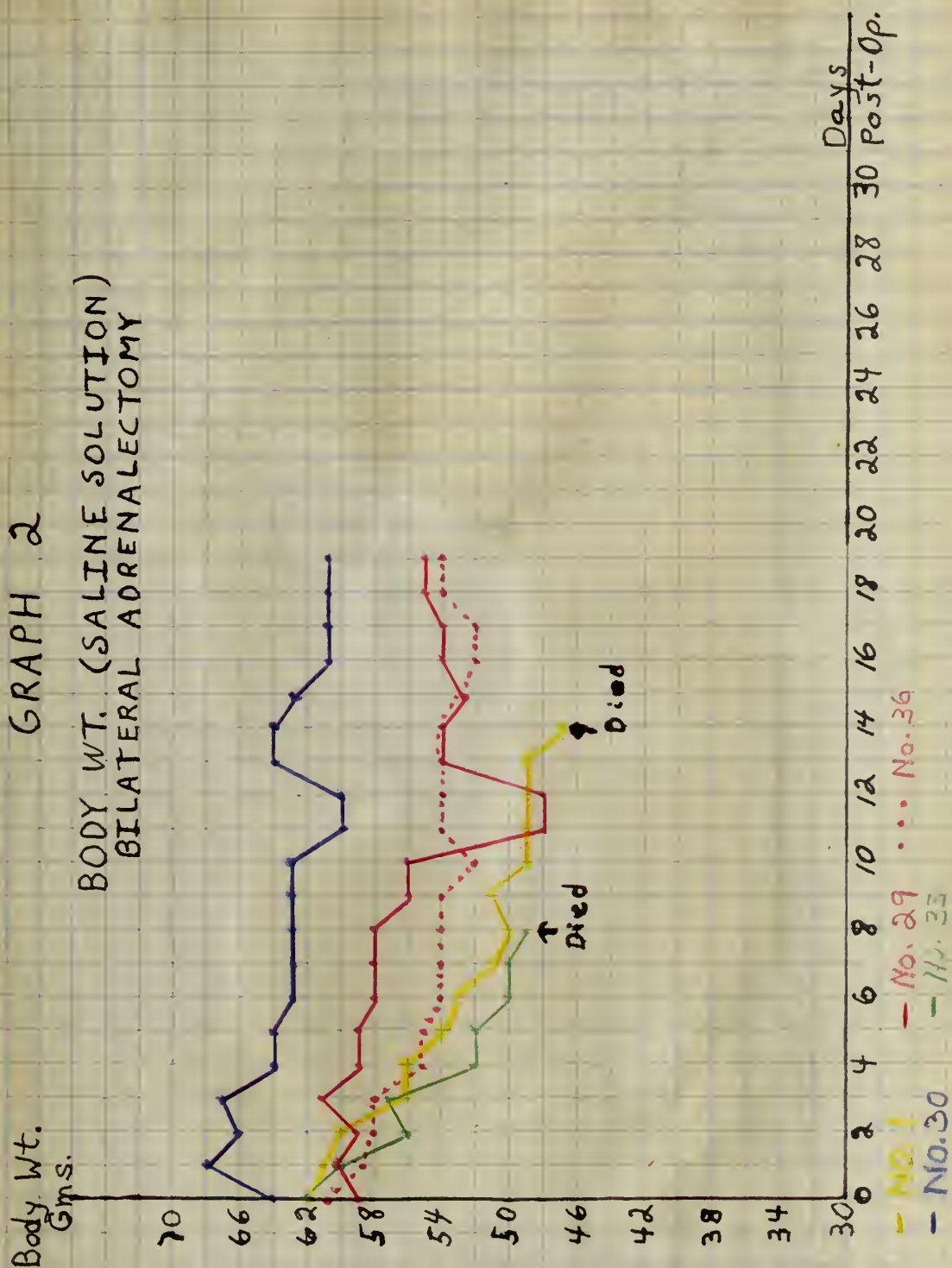




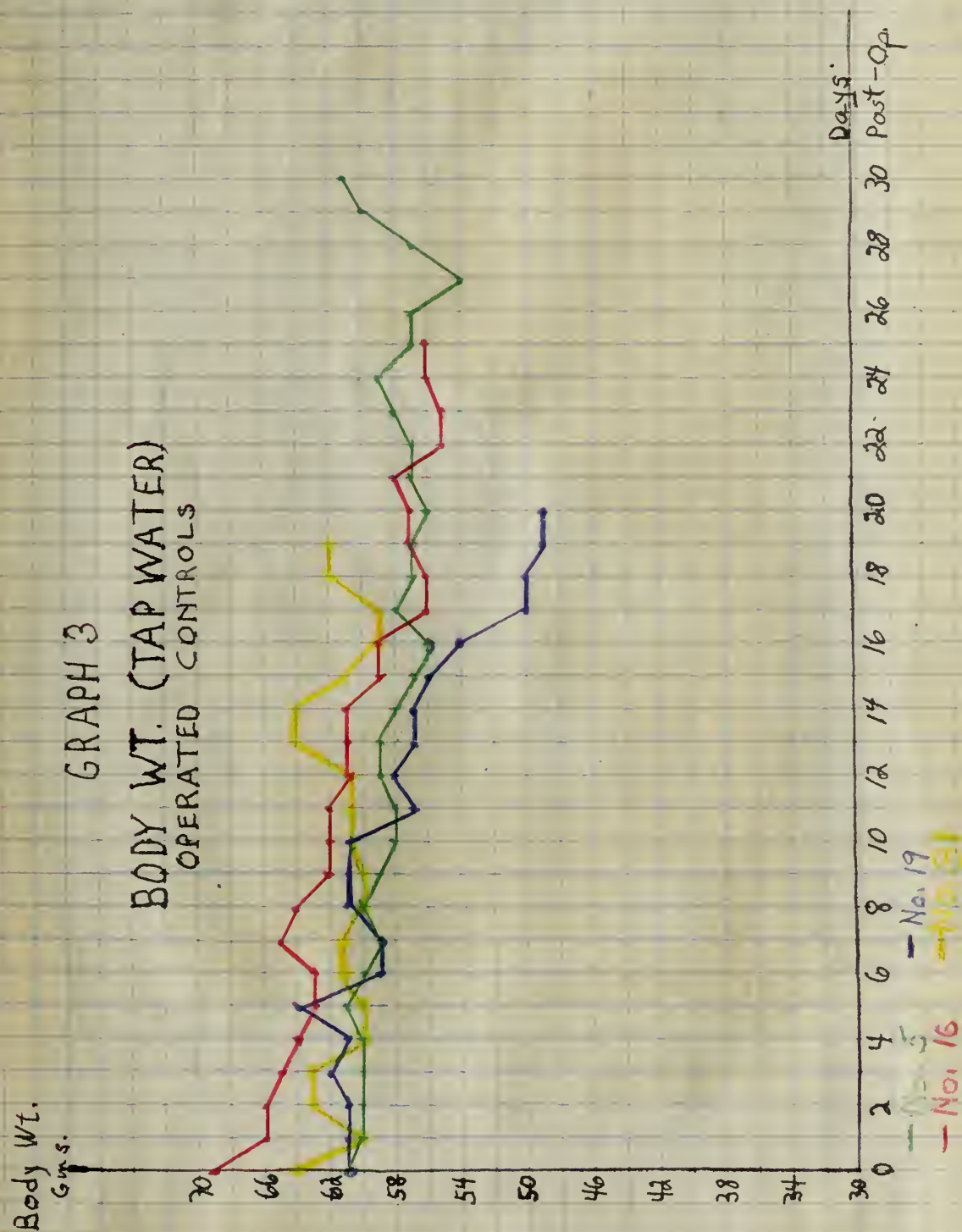




GRAPH 2  
BODY WT. (SALINE SOLUTION)  
BILATERAL ADRENALECTOMY

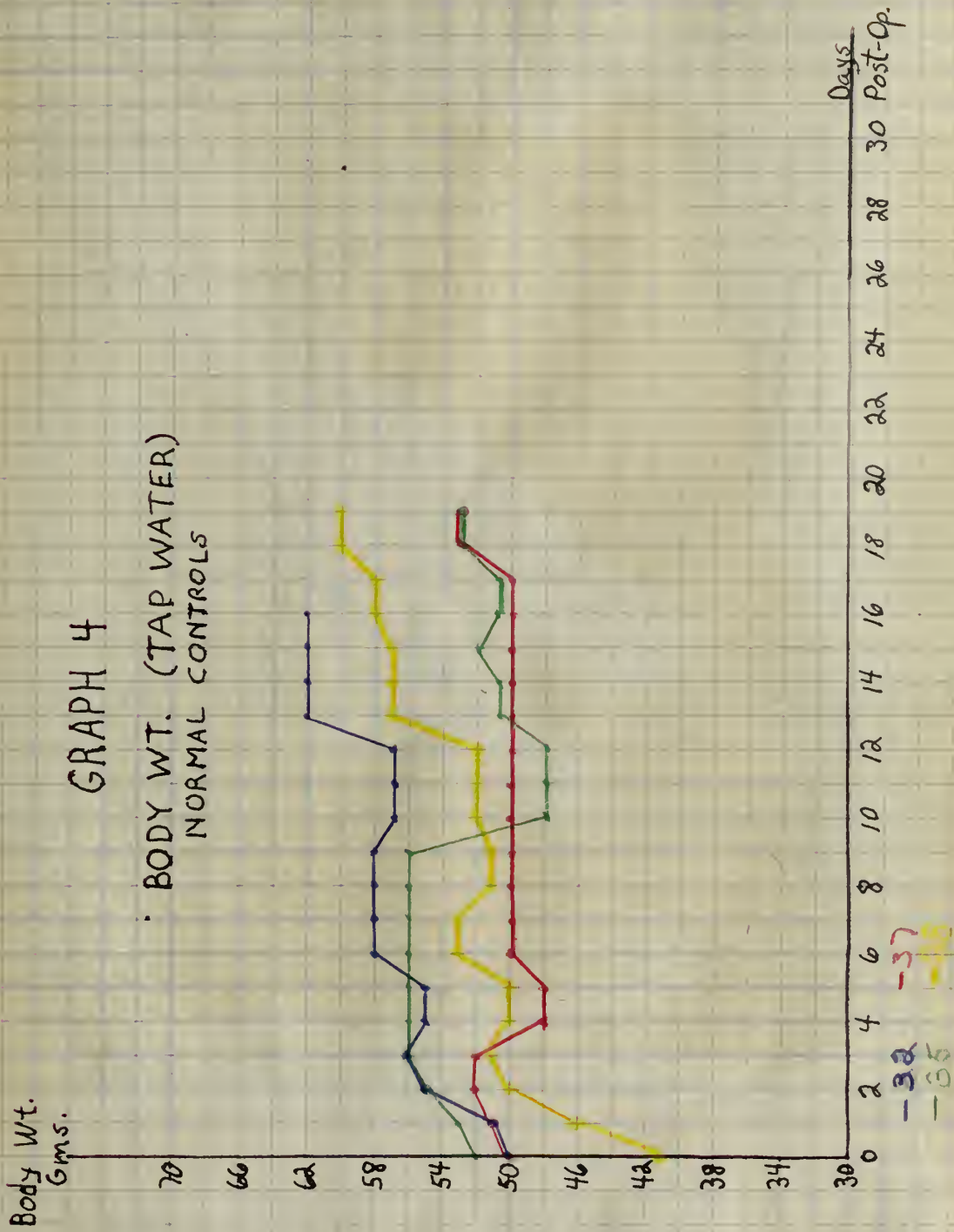
















## Chart I

Hamster No. 2

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Consumption (gm.)	Condition
0	58	---	20	---	Upper pole of right kidney injured in operation. Operative time 17 minutes.
1	56	17	17	3	Very active and alert. Sutures intact.
2	57	14	14	3	Good. Very active.
3	53	12	12	2	Good.
4	49	10	10	2	Alert. Getting weaker, however. Fur in good condition.
5	47	8	13	2	Weak, but still alert.
6	44	12	12	1	Fairly active and alert
7	42	10	10	2	Losing weight rapidly. Weak.
8	40	10	10	--	Found dead at 2:00 p.m. Death must have occurred some hours earlier

## Autopsy

Seminal vesicles and testes enlarged a great deal. ( Probably due to post-mortem change). Little or no body fat remaining. Blood vessels of intestines markedly distended. Liver spotty and congested. Spleen and thymus greatly enlarged. Lungs in good shape.

Section 1		Section 2		Section 3	
Sub-section 1.1		Sub-section 2.1		Sub-section 3.1	
Item 1.1.1		Item 2.1.1		Item 3.1.1	
Description of Item 1.1.1		Description of Item 2.1.1		Description of Item 3.1.1	
Value of Item 1.1.1		Value of Item 2.1.1		Value of Item 3.1.1	
1.1.1.1		2.1.1.1		3.1.1.1	
1.1.1.2		2.1.1.2		3.1.1.2	
1.1.1.3		2.1.1.3		3.1.1.3	
1.1.1.4		2.1.1.4		3.1.1.4	
1.1.1.5		2.1.1.5		3.1.1.5	
1.1.1.6		2.1.1.6		3.1.1.6	
1.1.1.7		2.1.1.7		3.1.1.7	
1.1.1.8		2.1.1.8		3.1.1.8	
1.1.1.9		2.1.1.9		3.1.1.9	
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1.1.1.11		2.1.1.11		3.1.1.11	
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1.1.1.26		2.1.1.26		3.1.1.26	
1.1.1.27		2.1.1.27		3.1.1.27	
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1.1.1.30		2.1.1.30		3.1.1.30	
1.1.1.31		2.1.1.31		3.1.1.31	
1.1.1.32		2.1.1.32		3.1.1.32	
1.1.1.33		2.1.1.33		3.1.1.33	
1.1.1.34		2.1.1.34		3.1.1.34	
1.1.1.35		2.1.1.35		3.1.1.35	
1.1.1.36		2.1.1.36		3.1.1.36	
1.1.1.37		2.1.1.37		3.1.1.37	
1.1.1.38		2.1.1.38		3.1.1.38	
1.1.1.39		2.1.1.39		3.1.1.39	
1.1.1.40		2.1.1.40		3.1.1.40	
1.1.1.41		2.1.1.41		3.1.1.41	
1.1.1.42		2.1.1.42		3.1.1.42	
1.1.1.43		2.1.1.43		3.1.1.43	
1.1.1.44		2.1.1.44		3.1.1.44	
1.1.1.45		2.1.1.45		3.1.1.45	
1.1.1.46		2.1.1.46		3.1.1.46	
1.1.1.47		2.1.1.47		3.1.1.47	
1.1.1.48		2.1.1.48		3.1.1.48	
1.1.1.49		2.1.1.49		3.1.1.49	
1.1.1.50		2.1.1.50		3.1.1.50	
1.1.1.51		2.1.1.51		3.1.1.51	
1.1.1.52		2.1.1.52		3.1.1.52	
1.1.1.53		2.1.1.53		3.1.1.53	
1.1.1.54		2.1.1.54		3.1.1.54	
1.1.1.55		2.1.1.55		3.1.1.55	
1.1.1.56		2.1.1.56		3.1.1.56	
1.1.1.57		2.1.1.57		3.1.1.57	
1.1.1.58		2.1.1.58		3.1.1.58	
1.1.1.59		2.1.1.59		3.1.1.59	
1.1.1.60		2.1.1.60		3.1.1.60	
1.1.1.61		2.1.1.61		3.1.1.61	
1.1.1.62		2.1.1.62		3.1.1.62	
1.1.1.63		2.1.1.63		3.1.1.63	
1.1.1.64		2.1.1.64		3.1.1.64	
1.1.1.65		2.1.1.65		3.1.1.65	
1.1.1.66		2.1.1.66		3.1.1.66	
1.1.1.67		2.1.1.67		3.1.1.67	
1.1.1.68		2.1.1.68		3.1.1.68	
1.1.1.69		2.1.1.69		3.1.1.69	
1.1.1.70		2.1.1.70		3.1.1.70	
1.1.1.71		2.1.1.71		3.1.1.71	
1.1.1.72		2.1.1.72		3.1.1.72	
1.1.1.73		2.1.1.73		3.1.1.73	
1.1.1.74		2.1.1.74		3.1.1.74	
1.1.1.75		2.1.1.75		3.1.1.75	
1.1.1.76		2.1.1.76		3.1.1.76	
1.1.1.77		2.1.1.77		3.1.1.77	
1.1.1.78		2.1.1.78		3.1.1.78	
1.1.1.79		2.1.1.79		3.1.1.79	
1.1.1.80		2.1.1.80		3.1.1.80	
1.1.1.81		2.1.1.81		3.1.1.81	
1.1.1.82		2.1.1.82		3.1.1.82	
1.1.1.83		2.1.1.83		3.1.1.83	
1.1.1.84		2.1.1.84		3.1.1.84	
1.1.1.85		2.1.1.85		3.1.1.85	
1.1.1.86		2.1.1.86		3.1.1.86	
1.1.1.87		2.1.1.87		3.1.1.87	
1.1.1.88		2.1.1.88		3.1.1.88	
1.1.1.89		2.1.1.89		3.1.1.89	
1.1.1.90		2.1.1.90		3.1.1.90	
1.1.1.91		2.1.1.91		3.1.1.91	
1.1.1.92		2.1.1.92		3.1.1.92	
1.1.1.93		2.1.1.93		3.1.1.93	
1.1.1.94		2.1.1.94		3.1.1.94	
1.1.1.95		2.1.1.95		3.1.1.95	
1.1.1.96		2.1.1.96		3.1.1.96	
1.1.1.97		2.1.1.97		3.1.1.97	
1.1.1.98		2.1.1.98		3.1.1.98	
1.1.1.99		2.1.1.99		3.1.1.99	
1.1.1.100		2.1.1.100		3.1.1.100	

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## Chart 2

Hamster No. 18

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	81	--	12	-	Operative time 35 minutes. Hemorrhage in area of left kidney.
1	76	10	10	2	Active and alert.
2	74	6	6	4	Active and alert.
3	67	1	14	5	Active and alert.
4	67	14	14	0	Still active and alert.
5	63	13	13	1	Active and alert.
6	61	13			Found dead at 8:30 p.m.

## Autopsy

Body fat normal. Lymph nodes not evident. Thymus not enlarged. A small area of congestion around the upper pole of the left kidney. The kidney itself was not injured. The left lobe of the liver appeared congested.

TABLE 1		PERCENTAGE OF TOTAL				
COUNTRY		1950	1955	1960	1965	1970
INDONESIA		100	100	100	100	100
MALAYSIA		100	100	100	100	100
SINGAPORE		100	100	100	100	100
THAILAND		100	100	100	100	100
VIETNAM		100	100	100	100	100
CAMBODIA		100	100	100	100	100
LAOS		100	100	100	100	100
BURMA		100	100	100	100	100
SRI LANKA		100	100	100	100	100
CEYLON		100	100	100	100	100
INDIA		100	100	100	100	100
PAKISTAN		100	100	100	100	100
AFGHANISTAN		100	100	100	100	100
IRAN		100	100	100	100	100
TURKEY		100	100	100	100	100
GREECE		100	100	100	100	100
ITALY		100	100	100	100	100
FRANCE		100	100	100	100	100
GERMANY		100	100	100	100	100
NETHERLANDS		100	100	100	100	100
BELGIUM		100	100	100	100	100
LUXEMBOURG		100	100	100	100	100
SWITZERLAND		100	100	100	100	100
AUSTRIA		100	100	100	100	100
DENMARK		100	100	100	100	100
FINLAND		100	100	100	100	100
NORWAY		100	100	100	100	100
SWEDEN		100	100	100	100	100
IRELAND		100	100	100	100	100
PORTUGAL		100	100	100	100	100
SPAIN		100	100	100	100	100
JAPAN		100	100	100	100	100
UNITED STATES		100	100	100	100	100
RUSSIA		100	100	100	100	100
CHINA		100	100	100	100	100
INDONESIA		100	100	100	100	100
MALAYSIA		100	100	100	100	100
SINGAPORE		100	100	100	100	100
THAILAND		100	100	100	100	100
VIETNAM		100	100	100	100	100
CAMBODIA		100	100	100	100	100
LAOS		100	100	100	100	100
BURMA		100	100	100	100	100
SRI LANKA		100	100	100	100	100
CEYLON		100	100	100	100	100
INDIA		100	100	100	100	100
PAKISTAN		100	100	100	100	100
AFGHANISTAN		100	100	100	100	100
IRAN		100	100	100	100	100
TURKEY		100	100	100	100	100
GREECE		100	100	100	100	100
ITALY		100	100	100	100	100
FRANCE		100	100	100	100	100
GERMANY		100	100	100	100	100
NETHERLANDS		100	100	100	100	100
BELGIUM		100	100	100	100	100
LUXEMBOURG		100	100	100	100	100
SWITZERLAND		100	100	100	100	100
AUSTRIA		100	100	100	100	100
DENMARK		100	100	100	100	100
FINLAND		100	100	100	100	100
NORWAY		100	100	100	100	100
SWEDEN		100	100	100	100	100
IRELAND		100	100	100	100	100
PORTUGAL		100	100	100	100	100
SPAIN		100	100	100	100	100
JAPAN		100	100	100	100	100
UNITED STATES		100	100	100	100	100
RUSSIA		100	100	100	100	100
CHINA		100	100	100	100	100

Source: United Nations, *World Development Report, 1970*.  
 Note: The figures in this table are percentages of the total population of each country in 1970. The figures for 1950 and 1955 are based on the 1950 and 1955 censuses respectively. The figures for 1960 and 1965 are based on the 1960 and 1965 censuses respectively. The figures for 1970 are based on the 1970 census.



## Chart 3

Hamster No. 20

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	82	--	12	-	Operative time 25 min.
1	74	12	12	0	Very active and alert.
2	73	11	11	1	Active and alert.
3	70	8	8	3	Active and alert. Inci- sion healing well.
4	66	8	8	0	Rather weak. Walks shakily. Irregular muscle twitches.
5	64	8			Found dead at 5:00 p.m.

## Autopsy

Not dead for long as auricular heart beat still present. Thymus normal. Lymph nodes not evident. Body fat reduced to some extent, but still present. Site of adrenals free from congestion or injury. Muscle incision almost completely healed.

The outer muscle walls of the stomach and duodenum appeared ulcerated. There also appeared to be an actual perforation of the stomach wall.

Description of Work	Amount				
	1900	1901	1902	1903	1904
1. (1) 1st 1st 1st 1st 1st	—	25	—	—	—
2. 2nd 2nd 2nd 2nd 2nd	—	—	—	—	—
3. 3rd 3rd 3rd 3rd 3rd	—	—	—	—	—
4. 4th 4th 4th 4th 4th	—	—	—	—	—
5. 5th 5th 5th 5th 5th	—	—	—	—	—
6. 6th 6th 6th 6th 6th	—	—	—	—	—
7. 7th 7th 7th 7th 7th	—	—	—	—	—
8. 8th 8th 8th 8th 8th	—	—	—	—	—
9. 9th 9th 9th 9th 9th	—	—	—	—	—
10. 10th 10th 10th 10th 10th	—	—	—	—	—

The above table shows the amount of work done in each year from 1900 to 1904. The work was done in five different categories, and the amount of work done in each category is shown in the table. The total amount of work done in each year is also shown in the table.

Chart 4

Hamster No. 4

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgtd (gm.)	Food Left (gm.)	Food Added (gm.)	Food Consumption (gm.)	Condition
0	60	--	22	---	10 minutes operative time. Upper pole of right kidney may have been injured in operation.
1	58	19	19	3	Good. Very active and alert.
2	58	15	15	4	Good.
3	57	10	10	5	Good.
4	55	5	25	5	Good.
5	59	24	24	1	Alert. Fur in good condition.
6	59	19	19	5	Good. Sutures still intact.
7	59	13	16	6	Good.
8	59	10	10	6	Good.
9	59	5	18	5	Good.
10	60	12	12	6	Good.
11	60	7	16	5	Good.
12	60	10	10	6	Good.
13	61	6	14	4	Good.
14	62	8	17	6	Good.
15	62	11	11	6	Good.
16	61	5	15	6	Good.
17	63	9	9	6	Good.

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(cont.)					Hamster No. 4
Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm. )	Food Consumption (gm.)	Condition
18	60	6	6	3	Good. Drop in body weight might be due to lack of heat in the animal room.
19	56	-	18	6	Good. Heat still off in animal room.
20	56	12	12	6	Good.
21	57	7	16	5	Good.
22	57	10	16	6	Good.
23	56	12	12	4	Good.
24	61	6	10	6	Good.
25	54	4	14	6	Good. Sudden drop in body weight unexplained.
26	54	8	13	6	Good.
27	52	12	12	1	Good.
28	56	10	10	2	Good.

Hamster sacrificed on the twenty-eighth day after the operation in order to check the operative technique. The animal was killed by an over-exposure to ether.

#### Autopsy

No evidence of adrenal tissue at poles of kidney--entirely removed by adrenalectomy. Body fat decreased very slightly in amount, otherwise a normal post-mortem appearance.



Date	Time	Temperature			
		Air	Water	Soil	Shade
Jan 1	10:00	50	45	40	42
Jan 2	11:00	52	47	42	44
Jan 3	12:00	55	50	45	47
Jan 4	13:00	58	53	48	50
Jan 5	14:00	60	55	50	52
Jan 6	15:00	62	57	52	54
Jan 7	16:00	65	60	55	57
Jan 8	17:00	68	63	58	60
Jan 9	18:00	70	65	60	62
Jan 10	19:00	72	67	62	64
Jan 11	20:00	75	70	65	67
Jan 12	21:00	78	73	68	70
Jan 13	22:00	80	75	70	72
Jan 14	23:00	82	77	72	74
Jan 15	00:00	85	80	75	77
Jan 16	01:00	88	83	78	80
Jan 17	02:00	90	85	80	82
Jan 18	03:00	92	87	82	84
Jan 19	04:00	95	90	85	87
Jan 20	05:00	98	93	88	90
Jan 21	06:00	100	95	90	92
Jan 22	07:00	102	97	92	94
Jan 23	08:00	105	100	95	97
Jan 24	09:00	108	103	98	100
Jan 25	10:00	110	105	100	102
Jan 26	11:00	112	107	102	104
Jan 27	12:00	115	110	105	107
Jan 28	13:00	118	113	108	110
Jan 29	14:00	120	115	110	112
Jan 30	15:00	122	117	112	114
Jan 31	16:00	125	120	115	117
Jan 32	17:00	128	123	118	120
Jan 33	18:00	130	125	120	122
Jan 34	19:00	132	127	122	124
Jan 35	20:00	135	130	125	127
Jan 36	21:00	138	133	128	130
Jan 37	22:00	140	135	130	132
Jan 38	23:00	142	137	132	134
Jan 39	00:00	145	140	135	137
Jan 40	01:00	148	143	138	140
Jan 41	02:00	150	145	140	142
Jan 42	03:00	152	147	142	144
Jan 43	04:00	155	150	145	147
Jan 44	05:00	158	153	148	150
Jan 45	06:00	160	155	150	152
Jan 46	07:00	162	157	152	154
Jan 47	08:00	165	160	155	157
Jan 48	09:00	168	163	158	160
Jan 49	10:00	170	165	160	162
Jan 50	11:00	172	167	162	164
Jan 51	12:00	175	170	165	167
Jan 52	13:00	178	173	168	170
Jan 53	14:00	180	175	170	172
Jan 54	15:00	182	177	172	174
Jan 55	16:00	185	180	175	177
Jan 56	17:00	188	183	178	180
Jan 57	18:00	190	185	180	182
Jan 58	19:00	192	187	182	184
Jan 59	20:00	195	190	185	187
Jan 60	21:00	198	193	188	190
Jan 61	22:00	200	195	190	192
Jan 62	23:00	202	197	192	194
Jan 63	00:00	205	200	195	197
Jan 64	01:00	208	203	198	200
Jan 65	02:00	210	205	200	202
Jan 66	03:00	212	207	202	204
Jan 67	04:00	215	210	205	207
Jan 68	05:00	218	213	208	210
Jan 69	06:00	220	215	210	212
Jan 70	07:00	222	217	212	214
Jan 71	08:00	225	220	215	217
Jan 72	09:00	228	223	218	220
Jan 73	10:00	230	225	220	222
Jan 74	11:00	232	227	222	224
Jan 75	12:00	235	230	225	227
Jan 76	13:00	238	233	228	230
Jan 77	14:00	240	235	230	232
Jan 78	15:00	242	237	232	234
Jan 79	16:00	245	240	235	237
Jan 80	17:00	248	243	238	240
Jan 81	18:00	250	245	240	242
Jan 82	19:00	252	247	242	244
Jan 83	20:00	255	250	245	247
Jan 84	21:00	258	253	248	250
Jan 85	22:00	260	255	250	252
Jan 86	23:00	262	257	252	254
Jan 87	00:00	265	260	255	257
Jan 88	01:00	268	263	258	260
Jan 89	02:00	270	265	260	262
Jan 90	03:00	272	267	262	264
Jan 91	04:00	275	270	265	267
Jan 92	05:00	278	273	268	270
Jan 93	06:00	280	275	270	272
Jan 94	07:00	282	277	272	274
Jan 95	08:00	285	280	275	277
Jan 96	09:00	288	283	278	280
Jan 97	10:00	290	285	280	282
Jan 98	11:00	292	287	282	284
Jan 99	12:00	295	290	285	287
Jan 100	13:00	298	293	288	290
Jan 101	14:00	300	295	290	292
Jan 102	15:00	302	297	292	294
Jan 103	16:00	305	300	295	297
Jan 104	17:00	308	303	298	300
Jan 105	18:00	310	305	300	302
Jan 106	19:00	312	307	302	304
Jan 107	20:00	315	310	305	307
Jan 108	21:00	318	313	308	310
Jan 109	22:00	320	315	310	312
Jan 110	23:00	322	317	312	314
Jan 111	00:00	325	320	315	317
Jan 112	01:00	328	323	318	320
Jan 113	02:00	330	325	320	322
Jan 114	03:00	332	327	322	324
Jan 115	04:00	335	330	325	327
Jan 116	05:00	338	333	328	330
Jan 117	06:00	340	335	330	332
Jan 118	07:00	342	337	332	334
Jan 119	08:00	345	340	335	337
Jan 120	09:00	348	343	338	340
Jan 121	10:00	350	345	340	342
Jan 122	11:00	352	347	342	344
Jan 123	12:00	355	350	345	347
Jan 124	13:00	358	353	348	350
Jan 125	14:00	360	355	350	352
Jan 126	15:00	362	357	352	354
Jan 127	16:00	365	360	355	357
Jan 128	17:00	368	363	358	360
Jan 129	18:00	370	365	360	362
Jan 130	19:00	372	367	362	364
Jan 131	20:00	375	370	365	367
Jan 132	21:00	378	373	368	370
Jan 133	22:00	380	375	370	372
Jan 134	23:00	382	377	372	374
Jan 135	00:00	385	380	375	377
Jan 136	01:00	388	383	378	380
Jan 137	02:00	390	385	380	382
Jan 138	03:00	392	387	382	384
Jan 139	04:00	395	390	385	387
Jan 140	05:00	398	393	388	390
Jan 141	06:00	400	395	390	392
Jan 142	07:00	402	397	392	394
Jan 143	08:00	405	400	395	397
Jan 144	09:00	408	403	398	400
Jan 145	10:00	410	405	400	402
Jan 146	11:00	412	407	402	404
Jan 147	12:00	415	410	405	407
Jan 148	13:00	418	413	408	410
Jan 149	14:00	420	415	410	412
Jan 150	15:00	422	417	412	414
Jan 151	16:00	425	420	415	417
Jan 152	17:00	428	423	418	420
Jan 153	18:00	430	425	420	422
Jan 154	19:00	432	427	422	424
Jan 155	20:00	435	430	425	427
Jan 156	21:00	438	433	428	430
Jan 157	22:00	440	435	430	432
Jan 158	23:00	442	437	432	434
Jan 159	00:00	445	440	435	437
Jan 160	01:00	448	443	438	440
Jan 161	02:00	450	445	440	442
Jan 162	03:00	452	447	442	444
Jan 163	04:00	455	450	445	447
Jan 164	05:00	458	453	448	450
Jan 165	06:00	460	455	450	452
Jan 166	07:00	462	457	452	454
Jan 167	08:00	465	460	455	457
Jan 168	09:00	468	463	458	460
Jan 169	10:00	470	465	460	462
Jan 170	11:00	472	467	462	464
Jan 171	12:00	475	470	465	467
Jan 172	13:00	478	473	468	470
Jan 173	14:00	480	475	470	472
Jan 174	15:00	482	477	472	474
Jan 175	16:00	485	480	475	477
Jan 176	17:00	488	483	478	480
Jan 177	18:00	490	485	480	482
Jan 178	19:00	492	487	482	484
Jan 179	20:00	495	490	485	487
Jan 180	21:00	498	493	488	490
Jan 181	22:00	500	495	490	492
Jan 182	23:00	502	497	492	494
Jan 183	00:00	505	500	495	497
Jan 184	01:00	508	503	498	500
Jan 185	02:00	510	505	500	502
Jan 186	03:00	512	507	502	504
Jan 187	04:00	515	510	505	507
Jan 188	05:00	518	513	508	510
Jan 189	06:00	520	515	510	512
Jan 190	07:00	522	517	512	514
Jan 191	08:00	525	520	515	517
Jan 192	09:00	528	523	518	520
Jan 193	10:00	530	525	520	522
Jan 194	11:00	532	527	522	524
Jan 195	12:00	535	530	525	527
Jan 196	13:00	538	533	528	530
Jan 197	14:00	540	535	530	532
Jan 198	15:00	542	537	532	534
Jan 199	16:00	545	540	535	537
Jan 200	17:00	548	543	538	540
Jan 201	18:00	550	545	540	542
Jan 202	19:00	552	547	542	544
Jan 203	20:00	555	550	545	547
Jan 204	21:00	558	553	548	550
Jan 205	22:00	560	555	550	552
Jan 206	23:00	562	557	552	554
Jan 207	00:00	565	560	555	557
Jan 208	01:00	568	563	558	560
Jan 209	02:00	570	565	560	562
Jan 210	03:00	572	567	562	564
Jan 211	04:00	575	570	565	567
Jan 212	05:00	578	573	568	570
Jan 213	06:00	580	575	570	572
Jan 214	07:00	582	577	572	574
Jan 215					

Chart 5

Hamster No.10

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	55	---	19	---	Operative time 20 minutes.
1	53	13	13	6	Good. Very active and alert.
2	52	7	20	6	Very active and alert.
3	53	17	17	3	Active and alert. Steady in weight.
4	52	14	14	3	Very active and alert.
5	51	9	13	5	Good.
6	52	10	10	3	Good.
7	51	6	6	4	Good.
8	51	2	17	4	Good.
9	50	15	15	2	Good.
10	52	13	13	2	Good.
11	52	11	12	2	Good.
12	52	7	14	5	Good.
13	52	9	9	5	Good.
14	49	5	5	4	Good.
15	49	---	16	5	Good.
16	51	9	9	7	Good. Active and alert. Wound well healed.
17	49	3	12	6	Good. Very active.
18	52	10	10	2	Good.
19	51	5	5	5	Active and alert.



(cont.)					Hamster No. 10
Days Post-Op.	Wgt (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
20	51	--	14	5	Active and alert. Incision healed.
21	49	9	9	5	Active and alert.
22	49	4	14	5	Active and alert.
23	52	9	9	5	Good.
24	51	5	13	4	Active and alert.
25	51	7	11	6	Active and alert.
26	52	7	7	4	Good.
27	52	2	14	5	Good.
28	52	9	9	5	Good.
29	52	4	11	5	Good.
30	52	6	12	5	Good.
31	51	8	8	4	Active and alert.
32	51	4	14	4	Active and alert.

#### Sacrificed

Adhesion of left kidney and spleen. Adhesion of liver and left kidney. No evidence of adrenal tissue, macroscopically. Viscera fixed in Bouin's.

Table 1. Summary of the data collected during the field study.

Location	Time	Temperature (°C)	Humidity (%)	Wind Speed (m/s)	Cloud Cover (%)
Station 1	08:00	25.0	65.0	1.5	10
Station 2	09:00	26.5	68.0	2.0	15
Station 3	10:00	28.0	70.0	2.5	20
Station 4	11:00	29.5	72.0	3.0	25
Station 5	12:00	31.0	75.0	3.5	30
Station 6	13:00	32.5	78.0	4.0	35
Station 7	14:00	34.0	80.0	4.5	40
Station 8	15:00	35.5	82.0	5.0	45
Station 9	16:00	37.0	85.0	5.5	50
Station 10	17:00	38.5	88.0	6.0	55
Station 11	18:00	40.0	90.0	6.5	60
Station 12	19:00	41.5	92.0	7.0	65
Station 13	20:00	43.0	95.0	7.5	70
Station 14	21:00	44.5	98.0	8.0	75
Station 15	22:00	46.0	100.0	8.5	80

Note: Data were collected at 15-minute intervals throughout the day.

The data were analyzed using a one-way ANOVA to determine the effect of time on the variables measured.

The results of the ANOVA are presented in Table 2.



Chart 6

Hamster No. 12

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	52	---	13	---	Operative time 15 minutes
1	56	11	22	2	Good. Active and alert.
2	51	20	12	2	Good. Active and alert.
3	50	8	15	4	Good. Active and alert.
4	51	9	9	6	Good. Active and alert.
5	51	5	12	4	Good.
6	52	8	8	4	Good.
7	49	5	5	3	Good.
8	49	2	13	3	Good.
9	51	9	9	4	Good.
10	48	6	6	3	Fairly good.
11	48	4	14	2	Fairly good.
12	46	13	13	1	Losing weight rapidly. Still fairly active.
13	47	9	9	4	Active. Seems to be in good condition.
14	49	6	6	3	Good. Active.
15	49	3	12	3	Good. Active.
16	47	8	12	4	Good. Active and alert.
17	49	6	11	6	Good. Hair beginning to grow back.
18	50	9	9	2	Good.
19	50	6	6	3	Good.



(cont.)

Hamster No. 12

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
20	50	2	12	4	Good.
21	50	8	8	4	Good.
22	50	4	11	4	Good.
23	49	6	6	5	Good.
24	48	6	11	0	weak. Body cold. walks very shakily.
25	50	7	7	4	Good. Much stronger. No shakes.
26	48	4	4	3	Good.
27	48	0	13	4	Good.
28	48	11	11	2	Good.
29	48	10	14	1	Good. Active.
30	47	10	10	4	Good.

## Sacrificed

No macroscopic evidence of adrenal tissue. Entire viscera fixed in Bouin's. Body fat normal. Normal post mortem picture.



## Chart 7

Hamster No. 15

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	80	----	18	---	Operative time 30 minutes.
1	76	16	16	2	Good. Incision shows no infection. Sutures intact. Very active and alert. Weight drop may be due to lack of water.
2	76	13	13	3	Good. Very active and alert.
3	79	9	12	4	Good.
4	72	10	10	2	Fairly good. Active
5	72	8	8	2	Fairly good. Active.
6	72	4	3	14	Good.
7	72	10	10	3	Good.
8	68	6	6	4	Good. Active and alert.
9	68	1	13	5	Good. Active and alert.
10	67	8	12	5	Good. Wound almost completely healed. Active and alert.
11	70	5	12	7	Good. Incision completely healed.
12	70	8	8	4	Good.
13	66	4	4	4	Active and alert.
14	66	0	16	4	Active and alert.
15	66	11	11	5	Active and alert.
16	66	6	9	5	Active and alert.
17	66	5	16	4	Good.





(cont.)

Hamster No. 15

Days Post-Op.	Wgt. (gm.)	Food Left. (GM.)	Food Added (gm.)	Food Intake (gm.)	Condition
18	69	10	10	6	Active and alert.
19	69	5	10	5	Active and alert.
20	64	5	5	5	Good.
21	64	0	16	5	Good.
22	68	9	9	7	Good. Active and alert.
23	68	3	13	6	Good. Active and alert.
24	69	8	8	5	Good.
25	62	4	4	4	Good.
26	62	0	18	4	Good.

Date		Description		Amount	
1900	Jan 1	Balance		100.00	
		Jan 5	Jan 5	10.00	110.00
		Jan 10	Jan 10	20.00	130.00
		Jan 15	Jan 15	30.00	160.00
		Jan 20	Jan 20	40.00	200.00
		Jan 25	Jan 25	50.00	250.00
		Jan 30	Jan 30	60.00	310.00
		Jan 31	Jan 31	70.00	380.00
		Feb 1	Feb 1	80.00	460.00
		Feb 5	Feb 5	90.00	550.00
		Feb 10	Feb 10	100.00	650.00
		Feb 15	Feb 15	110.00	760.00
		Feb 20	Feb 20	120.00	880.00
		Feb 25	Feb 25	130.00	1010.00
		Feb 28	Feb 28	140.00	1150.00
		Feb 29	Feb 29	150.00	1300.00
		Mar 1	Mar 1	160.00	1460.00
		Mar 5	Mar 5	170.00	1630.00
		Mar 10	Mar 10	180.00	1810.00
		Mar 15	Mar 15	190.00	2000.00
		Mar 20	Mar 20	200.00	2200.00
		Mar 25	Mar 25	210.00	2410.00
		Mar 30	Mar 30	220.00	2630.00
		Mar 31	Mar 31	230.00	2860.00
		Apr 1	Apr 1	240.00	3100.00
		Apr 5	Apr 5	250.00	3350.00
		Apr 10	Apr 10	260.00	3610.00
		Apr 15	Apr 15	270.00	3880.00
		Apr 20	Apr 20	280.00	4160.00
		Apr 25	Apr 25	290.00	4450.00
		Apr 30	Apr 30	300.00	4750.00
		Apr 31	Apr 31	310.00	5060.00
		May 1	May 1	320.00	5380.00
		May 5	May 5	330.00	5710.00
		May 10	May 10	340.00	6050.00
		May 15	May 15	350.00	6400.00
		May 20	May 20	360.00	6760.00
		May 25	May 25	370.00	7130.00
		May 30	May 30	380.00	7510.00
		May 31	May 31	390.00	7900.00
		Jun 1	Jun 1	400.00	8300.00
		Jun 5	Jun 5	410.00	8710.00
		Jun 10	Jun 10	420.00	9130.00
		Jun 15	Jun 15	430.00	9560.00
		Jun 20	Jun 20	440.00	10000.00
		Jun 25	Jun 25	450.00	10450.00
		Jun 30	Jun 30	460.00	10910.00
		Jun 31	Jun 31	470.00	11380.00
		Jul 1	Jul 1	480.00	11860.00
		Jul 5	Jul 5	490.00	12350.00
		Jul 10	Jul 10	500.00	12850.00
		Jul 15	Jul 15	510.00	13360.00
		Jul 20	Jul 20	520.00	13880.00
		Jul 25	Jul 25	530.00	14410.00
		Jul 30	Jul 30	540.00	14950.00
		Jul 31	Jul 31	550.00	15500.00
		Aug 1	Aug 1	560.00	16060.00
		Aug 5	Aug 5	570.00	16630.00
		Aug 10	Aug 10	580.00	17210.00
		Aug 15	Aug 15	590.00	17800.00
		Aug 20	Aug 20	600.00	18400.00
		Aug 25	Aug 25	610.00	19010.00
		Aug 30	Aug 30	620.00	19630.00
		Aug 31	Aug 31	630.00	20260.00
		Sep 1	Sep 1	640.00	20900.00
		Sep 5	Sep 5	650.00	21550.00
		Sep 10	Sep 10	660.00	22210.00
		Sep 15	Sep 15	670.00	22880.00
		Sep 20	Sep 20	680.00	23560.00
		Sep 25	Sep 25	690.00	24250.00
		Sep 30	Sep 30	700.00	24950.00
		Sep 31	Sep 31	710.00	25660.00
		Oct 1	Oct 1	720.00	26380.00
		Oct 5	Oct 5	730.00	27110.00
		Oct 10	Oct 10	740.00	27850.00
		Oct 15	Oct 15	750.00	28600.00
		Oct 20	Oct 20	760.00	29360.00
		Oct 25	Oct 25	770.00	30130.00
		Oct 30	Oct 30	780.00	30910.00
		Oct 31	Oct 31	790.00	31700.00
		Nov 1	Nov 1	800.00	32500.00
		Nov 5	Nov 5	810.00	33310.00
		Nov 10	Nov 10	820.00	34130.00
		Nov 15	Nov 15	830.00	34960.00
		Nov 20	Nov 20	840.00	35800.00
		Nov 25	Nov 25	850.00	36650.00
		Nov 30	Nov 30	860.00	37510.00
		Nov 31	Nov 31	870.00	38380.00
		Dec 1	Dec 1	880.00	39260.00
		Dec 5	Dec 5	890.00	40150.00
		Dec 10	Dec 10	900.00	41050.00
		Dec 15	Dec 15	910.00	41960.00
		Dec 20	Dec 20	920.00	42880.00
		Dec 25	Dec 25	930.00	43810.00
		Dec 30	Dec 30	940.00	44750.00
		Dec 31	Dec 31	950.00	45700.00

Chart 8

Hamster No. 17

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	72	---	12	---	Operative time 35 minutes.
1	71	9	9	3	Recovered from operation in good condition. Active and alert.
2	69	6	6	3	Good. Active and alert.
3	65	4	4	2	Good. Active and alert.
4	65	1	12	3	Good. Active and alert.
5	64	9	9	3	Good. Active and alert.
6	64	3	14	6	Very active and alert.
7	63	11	11	3	Active and alert.
8	57	8	8	3	Active and alert. Incision healing well.
9	57	6	13	2	Good.
10	57	8	8	5	Good.
11	57	4	14	4	Active and alert.
12	58	11	11	3	Active and alert.
13	58	6	13	5	Good.
14	54	13	13	0	Good.
15	51	8	8	5	Good.
16	51	4	13	4	Active and alert.
17	52	9	9	4	Active and alert.
18	52	5	13	4	Good.
19	51	7	11	6	Good.





(cont.)

Hamster No. 17

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
20	51	6	6	5	Active and alert.
21	51	1	14	5	Active and alert.
22	48	11	11	3	Good.
23	48	9	15	2	Good.

Date	Time	Temp	Wind	Clouds	Remarks
Jan 10 1900	8:00	55	S 10	B	Clear
Jan 11 1900	8:00	58	S 12	B	Clear
Jan 12 1900	8:00	60	S 15	B	Clear
Jan 13 1900	8:00	62	S 18	B	Clear
Jan 14 1900	8:00	65	S 20	B	Clear

## Chart 9

Hamster No. 25

Tap Water

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	57	--	13	-	Operative time twenty minutes.
1	55	11	11	2	Active and alert.
2	55	9	9	2	Active and alert.
3	51	7	13	2	No evidence of infection. Active and alert.
4	51	10	10	3	Good.
5	52	8	8	2	Very active and alert.
6	49	4	4	4	Active and alert.
7	49	0	12	4	Active and alert.
8	49	8	8	4	Active. Incision healing.
9	49	4	10	4	Good.
10	50	6	6	4	Good.
11	49	2	14	4	Active and alert. Suture broken, but incision healing well.
12	50	9	9	5	Good.
13	49	4	4	5	Good.
14	49	0	12	4	Good.
15	51	8	8	4	Good. Incision healed.
16	51	4	12	4	Good.
17	52	6	13	6	Active and alert.
18	51	7	7	6	Active and alert.

Date		Description		Amount	
1900	Jan 1	Balance		100.00	
	Jan 5	Received from A		50.00	
	Jan 10	Received from B		25.00	
	Jan 15	Received from C		75.00	
	Jan 20	Received from D		100.00	
	Jan 25	Received from E		50.00	
	Jan 30	Received from F		25.00	
	Feb 1	Received from G		75.00	
	Feb 5	Received from H		100.00	
	Feb 10	Received from I		50.00	
	Feb 15	Received from J		25.00	
	Feb 20	Received from K		75.00	
	Feb 25	Received from L		100.00	
	Feb 30	Received from M		50.00	
	Mar 1	Received from N		25.00	
	Mar 5	Received from O		75.00	
	Mar 10	Received from P		100.00	
	Mar 15	Received from Q		50.00	
	Mar 20	Received from R		25.00	
	Mar 25	Received from S		75.00	
	Mar 30	Received from T		100.00	
	Apr 1	Received from U		50.00	
	Apr 5	Received from V		25.00	
	Apr 10	Received from W		75.00	
	Apr 15	Received from X		100.00	
	Apr 20	Received from Y		50.00	
	Apr 25	Received from Z		25.00	
	Apr 30	Received from AA		75.00	
	May 1	Received from AB		100.00	
	May 5	Received from AC		50.00	
	May 10	Received from AD		25.00	
	May 15	Received from AE		75.00	
	May 20	Received from AF		100.00	
	May 25	Received from AG		50.00	
	May 30	Received from AH		25.00	
	Jun 1	Received from AI		75.00	
	Jun 5	Received from AJ		100.00	
	Jun 10	Received from AK		50.00	
	Jun 15	Received from AL		25.00	
	Jun 20	Received from AM		75.00	
	Jun 25	Received from AN		100.00	
	Jun 30	Received from AO		50.00	
	Jul 1	Received from AP		25.00	
	Jul 5	Received from AQ		75.00	
	Jul 10	Received from AR		100.00	
	Jul 15	Received from AS		50.00	
	Jul 20	Received from AT		25.00	
	Jul 25	Received from AU		75.00	
	Jul 30	Received from AV		100.00	
	Aug 1	Received from AW		50.00	
	Aug 5	Received from AX		25.00	
	Aug 10	Received from AY		75.00	
	Aug 15	Received from AZ		100.00	
	Aug 20	Received from BA		50.00	
	Aug 25	Received from BB		25.00	
	Aug 30	Received from BC		75.00	
	Sep 1	Received from BD		100.00	
	Sep 5	Received from BE		50.00	
	Sep 10	Received from BF		25.00	
	Sep 15	Received from BG		75.00	
	Sep 20	Received from BH		100.00	
	Sep 25	Received from BI		50.00	
	Sep 30	Received from BJ		25.00	
	Oct 1	Received from BK		75.00	
	Oct 5	Received from BL		100.00	
	Oct 10	Received from BM		50.00	
	Oct 15	Received from BN		25.00	
	Oct 20	Received from BO		75.00	
	Oct 25	Received from BP		100.00	
	Oct 30	Received from BQ		50.00	
	Nov 1	Received from BR		25.00	
	Nov 5	Received from BS		75.00	
	Nov 10	Received from BT		100.00	
	Nov 15	Received from BU		50.00	
	Nov 20	Received from BV		25.00	
	Nov 25	Received from BW		75.00	
	Nov 30	Received from BX		100.00	
	Dec 1	Received from BY		50.00	
	Dec 5	Received from BZ		25.00	
	Dec 10	Received from CA		75.00	
	Dec 15	Received from CB		100.00	
	Dec 20	Received from CC		50.00	
	Dec 25	Received from CD		25.00	
	Dec 30	Received from CE		75.00	
	Jan 1	Received from CF		100.00	
	Jan 5	Received from CG		50.00	
	Jan 10	Received from CH		25.00	
	Jan 15	Received from CI		75.00	
	Jan 20	Received from CJ		100.00	
	Jan 25	Received from CK		50.00	
	Jan 30	Received from CL		25.00	
	Feb 1	Received from CM		75.00	
	Feb 5	Received from CN		100.00	
	Feb 10	Received from CO		50.00	
	Feb 15	Received from CP		25.00	
	Feb 20	Received from CQ		75.00	
	Feb 25	Received from CR		100.00	
	Feb 30	Received from CS		50.00	
	Mar 1	Received from CT		25.00	
	Mar 5	Received from CU		75.00	
	Mar 10	Received from CV		100.00	
	Mar 15	Received from CW		50.00	
	Mar 20	Received from CX		25.00	
	Mar 25	Received from CY		75.00	
	Mar 30	Received from CZ		100.00	
	Apr 1	Received from DA		50.00	
	Apr 5	Received from DB		25.00	
	Apr 10	Received from DC		75.00	
	Apr 15	Received from DD		100.00	
	Apr 20	Received from DE		50.00	
	Apr 25	Received from DF		25.00	
	Apr 30	Received from DG		75.00	
	May 1	Received from DH		100.00	
	May 5	Received from DI		50.00	
	May 10	Received from DJ		25.00	
	May 15	Received from DK		75.00	
	May 20	Received from DL		100.00	
	May 25	Received from DM		50.00	
	May 30	Received from DN		25.00	
	Jun 1	Received from DO		75.00	
	Jun 5	Received from DP		100.00	
	Jun 10	Received from DQ		50.00	
	Jun 15	Received from DR		25.00	
	Jun 20	Received from DS		75.00	
	Jun 25	Received from DT		100.00	
	Jun 30	Received from DU		50.00	
	Jul 1	Received from DV		25.00	
	Jul 5	Received from DW		75.00	
	Jul 10	Received from DX		100.00	
	Jul 15	Received from DY		50.00	
	Jul 20	Received from DZ		25.00	
	Jul 25	Received from EA		75.00	
	Jul 30	Received from EB		100.00	
	Aug 1	Received from EC		50.00	
	Aug 5	Received from ED		25.00	
	Aug 10	Received from EE		75.00	
	Aug 15	Received from EF		100.00	
	Aug 20	Received from EG		50.00	
	Aug 25	Received from EH		25.00	
	Aug 30	Received from EI		75.00	
	Sep 1	Received from EJ		100.00	
	Sep 5	Received from EK		50.00	
	Sep 10	Received from EL		25.00	
	Sep 15	Received from EM		75.00	
	Sep 20	Received from EN		100.00	
	Sep 25	Received from EO		50.00	
	Sep 30	Received from EP		25.00	
	Oct 1	Received from EQ		75.00	
	Oct 5	Received from ER		100.00	
	Oct 10	Received from ES		50.00	
	Oct 15	Received from ET		25.00	
	Oct 20	Received from EU		75.00	
	Oct 25	Received from EV		100.00	
	Oct 30	Received from EW		50.00	
	Nov 1	Received from EX		25.00	
	Nov 5	Received from EY		75.00	
	Nov 10	Received from EZ		100.00	
	Nov 15	Received from FA		50.00	
	Nov 20	Received from FB		25.00	
	Nov 25	Received from FC		75.00	
	Nov 30	Received from FD		100.00	
	Dec 1	Received from FE		50.00	
	Dec 5	Received from FF		25.00	
	Dec 10	Received from FG		75.00	
	Dec 15	Received from FH		100.00	
	Dec 20	Received from FI		50.00	
	Dec 25	Received from FJ		25.00	
	Dec 30	Received from FK		75.00	
	Jan 1	Received from FL		100.00	
	Jan 5	Received from FM		50.00	
	Jan 10	Received from FN		25.00	
	Jan 15	Received from FO		75.00	
	Jan 20	Received from FP		100.00	
	Jan 25	Received from FQ		50.00	
	Jan 30	Received from FR		25.00	
	Feb 1	Received from FS		75.00	
	Feb 5	Received from FT		100.00	
	Feb 10	Received from FU		50.00	
	Feb 15	Received from FV		25.00	
	Feb 20	Received from FW		75.00	
	Feb 25	Received from FX		100.00	
	Feb 30	Received from FY		50.00	
	Mar 1	Received from FZ		25.00	
	Mar 5	Received from GA		75.00	
	Mar 10	Received from GB		100.00	
	Mar 15	Received from GC		50.00	
	Mar 20	Received from GD		25.00	
	Mar 25	Received from GE		75.00	
	Mar 30	Received from GF		100.00	
	Apr 1	Received from GG		50.00	
	Apr 5	Received from GH		25.00	
	Apr 10	Received from GI		75.00	
	Apr 15	Received from GJ		100.00	
	Apr 20	Received from GK		50.00	
	Apr 25	Received from GL		25.00	
	Apr 30	Received from GM		75.00	
	May 1	Received from GN		100.00	
	May 5	Received from GO		50.00	
	May 10	Received from GP		25.00	
	May 15	Received from GQ		75.00	
	May 20	Received from GR		100.00	
	May 25	Received from GS		50.00	
	May 30	Received from GT		25.00	
	Jun 1	Received from GU		75.00	
	Jun 5	Received from GV		100.00	
	Jun 10	Received from GW		50.00	
	Jun 15	Received from GX		25.00	
	Jun 20	Received from GY		75.00	
	Jun 25	Received from GZ		100.00	
	Jun 30	Received from HA		50.00	
	Jul 1	Received from HB		25.00	
	Jul 5	Received from HC		75.00	
	Jul 10	Received from HD		100.00	
	Jul 15	Received from HE		50.00	
	Jul 20	Received from HF		25.00	
	Jul 25	Received from HG		75.00	
	Jul 30	Received from HH		100.00	
	Aug 1	Received from HI		50.00	
	Aug 5	Received from HJ		25.00	
	Aug 10	Received from HK		75.00	
	Aug 15	Received from HL		100.00	
	Aug 20	Received from HM		50.00	
	Aug 25	Received from HN		25.00	
	Aug 30	Received from HO		75.00	
	Sep 1	Received from HP		100.00	
	Sep 5	Received from HQ		50.00	
	Sep 10	Received from HR		25.00	
	Sep 15	Received from HS		75.00	
	Sep 20	Received from HT		100.00	
	Sep 25	Received from HU		50.00	
	Sep 30	Received from HV		25.00	
	Oct 1	Received from HW		75.00	
	Oct 5	Received from HX		100.00	
	Oct 10	Received from HY		50.00	
	Oct 15	Received from HZ		25.00	
	Oct 20	Received from IA		75.00	
	Oct 25	Received from IB		100.00	
	Oct 30	Received from IC		50.00	
	Nov 1	Received from ID		25.00	
	Nov 5	Received from IE		75.00	
	Nov 10	Received from IF		100.00	
	Nov 15	Received from IG		50.00	
	Nov 20	Received from IH		25.00	
	Nov 25	Received from II		75.00	
	Nov 30	Received from IJ		100.00	
	Dec 1	Received from IK		50.00	
	Dec 5	Received from IL		25.00	
	Dec 10	Received from IM		75.00	
	Dec 15	Received from IN		100.00	
	Dec 20	Received from IO		50.00	
	Dec 25	Received from IP		25.00	
	Dec 30	Received from IQ		75.00	
	Jan 1	Received from IR		100.00	
	Jan 5	Received from IS		50.00	
	Jan 10	Received from IT		25.00	
	Jan 15	Received from IU		75.00	
	Jan 20	Received from IV		100.00	
	Jan 25	Received from IW		50.00	
	Jan 30	Received from IX		25.00	
	Feb 1	Received from IY		75.00	
	Feb 5	Received from IZ		100.00	
	Feb 10	Received from JA		50.00	
	Feb 15	Received from JB		25.00	
	Feb 20	Received from JC		75.00	
	Feb 25	Received from JD		100.00	
	Feb 30	Received from JE		50.00	
	Mar 1	Received from JF		25.00	
	Mar 5	Received from JG		75.00	
	Mar 10	Received from JH		100.00	
	Mar 15	Received from JI		50.00	
	Mar 20	Received from JJ		25.00	
	Mar 25	Received from JK		75.00	
	Mar 30	Received			

(cont.)

Hamster No. 25

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
19	51	1	17	6	Good.
20	53	9	16	8	Good.
21	53	16	16	0	Active and alert.





## Chart 10

Hamster No. 34

Saline Solution

Bilateral  
Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	62	---	18	---	Operative time 12 minutes. Left incision not sutured.
1	59	17	17	1	Good. Active and alert. Incision in good condition. Sutures not broken.
2	54	14	14	3	Good. Sutures ripped out.
3	52	11	17	3	Good. Active and alert.
4	50	16	16	1	Very, very weak.
5	50	16	16	1	Very, very weak. Dying. Body cold. Gasping, forced breathing. Died at 5:00 p.m.

## Autopsy

Left muscle incision healed. Right muscle incision healed. Body fat not reduced. Blood clot in region of left adrenal. Right adrenal area clear. No sign of congestion. Lungs slightly congested. Thymus normal.

Date		Description		Amount	
1900	Jan 1	Balance		100.00	
	Feb 1	Interest		5.00	
	Mar 1	Interest		5.00	
	Apr 1	Interest		5.00	
	May 1	Interest		5.00	
	Jun 1	Interest		5.00	
	Jul 1	Interest		5.00	
	Aug 1	Interest		5.00	
	Sep 1	Interest		5.00	
	Oct 1	Interest		5.00	
	Nov 1	Interest		5.00	
	Dec 1	Interest		5.00	
1901	Jan 1	Balance		100.00	
	Feb 1	Interest		5.00	
	Mar 1	Interest		5.00	
	Apr 1	Interest		5.00	
	May 1	Interest		5.00	
	Jun 1	Interest		5.00	
	Jul 1	Interest		5.00	
	Aug 1	Interest		5.00	
	Sep 1	Interest		5.00	
	Oct 1	Interest		5.00	
	Nov 1	Interest		5.00	
	Dec 1	Interest		5.00	
1902	Jan 1	Balance		100.00	
	Feb 1	Interest		5.00	
	Mar 1	Interest		5.00	
	Apr 1	Interest		5.00	
	May 1	Interest		5.00	
	Jun 1	Interest		5.00	
	Jul 1	Interest		5.00	
	Aug 1	Interest		5.00	
	Sep 1	Interest		5.00	
	Oct 1	Interest		5.00	
	Nov 1	Interest		5.00	
	Dec 1	Interest		5.00	

Chart 11

Hamster No. 1

Saline Solution		Bilateral Adrenalectomy			Condition
Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Consumption (gm.)	
0	62	---	28	----	20 min. operative time Recovered in 15. min.
1	61	28	28	0	Very active. Sutures intact.
2	60	23	23	5	Active. No infection
3	58	20	20	3	Active and alert.
4	56	18	18	2	Active and alert.
5	54	17	17	1	Good. Loss in weight may be due to lack of drinking water.
6	53	16	16	1	Good. Fur in good condition.
7	51	13	13	3	Good.
8	50	10	10	3	Fairly active.
9	51	7	11	3	Good.
10	49	7	21	4	Good. Fairly active.
11	49	18	18	3	Less active.
12	49	17	17	1	Getting weaker.
13	49	14	14	3	Weak, not active.
14	47	13	13	1	Very weak, no activity at all.

Died on 14th day post-op. Period before death characterized by extreme lassitude and weakness. Periodic muscle twitches and occasional convulsive movements of the body.

#### Autopsy

Performed immediately after death. Body fat had disappeared. Lymph nodes not too evident. Thymus slightly enlarged. Blood vessels in mesentary extended to some degree. Lungs in good condition.

# Table 1

Category	Sub-category	Value 1	Value 2	Value 3	Value 4	Value 5
Group 1	Item 1.1	10	20	30	40	50
Group 1	Item 1.2	15	25	35	45	55
Group 1	Item 1.3	20	30	40	50	60
Group 1	Item 1.4	25	35	45	55	65
Group 1	Item 1.5	30	40	50	60	70
Group 1	Item 1.6	35	45	55	65	75
Group 1	Item 1.7	40	50	60	70	80
Group 1	Item 1.8	45	55	65	75	85
Group 1	Item 1.9	50	60	70	80	90
Group 1	Item 1.10	55	65	75	85	95
Group 2	Item 2.1	60	70	80	90	100
Group 2	Item 2.2	65	75	85	95	105
Group 2	Item 2.3	70	80	90	100	110
Group 2	Item 2.4	75	85	95	105	115
Group 2	Item 2.5	80	90	100	110	120
Group 2	Item 2.6	85	95	105	115	125
Group 2	Item 2.7	90	100	110	120	130
Group 2	Item 2.8	95	105	115	125	135
Group 2	Item 2.9	100	110	120	130	140
Group 2	Item 2.10	105	115	125	135	145

Notes: The data in this table are based on the results of the survey conducted in the year 2000. The values are presented in the order of increasing magnitude. The data are subject to change in future years.



## Chart 12

Hamster No. 33

Saline Solution

Bilateral Adrenalectomy

Days Post-Op.	wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	62	--	10	-	Operative time 20 minutes.
1	60	7	7	3	Good. Very active and alert.
2	56	3	16	4	Very active and alert.
3	57	14	14	2	Very active and alert.
4	52	12	12	2	Active and alert. Incision healing well.
5	52	11	11	1	Active and alert.
6	50	9	9	2	Very active and alert.
7	50	8	8	1	Active and alert.
8	49	8			Found dead at 12:30 p.m.

## Autopsy

Body fat normal. Lymph nodes not evident. Thy mus normal.  
Lungs normal. Possible perforation of the intestine.

# Table 1

Table 1. Summary of data for the first 10 years of the study.

Table 1. Summary of data for the first 10 years of the study.

Table 1. Summary of data for the first 10 years of the study.

Year	Area (km <sup>2</sup> )	Area (km <sup>2</sup> )	Area (km <sup>2</sup> )	Area (km <sup>2</sup> )	Area (km <sup>2</sup> )
1990	100	100	100	100	100
1991	100	100	100	100	100
1992	100	100	100	100	100
1993	100	100	100	100	100
1994	100	100	100	100	100
1995	100	100	100	100	100
1996	100	100	100	100	100
1997	100	100	100	100	100
1998	100	100	100	100	100
1999	100	100	100	100	100
2000	100	100	100	100	100

## Table 2

Table 2. Summary of data for the first 10 years of the study.

Table 2. Summary of data for the first 10 years of the study.

Chart 13

Hamster No. 29

Saline Solution

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	59	---	13	---	Operative time 15 minutes
1	60	10	10	3	Good. Very active. Sut- ures still in place.
2	59	5	14	5	Good. Sutures in place. Incision healing.
3	61	9	9	5	Good. Sutures in place. Incision healing.
4	59	6	6	3	Active and alert. Incision healing well.
5	59	2	17	4	Active and alert. Incision healing well.
6	58	4	4	3	Active and alert.
7	58	10	10	4	Active and alert.
8	58	6	6	4	Active and alert.
9	56	1	14	5	Active and alert.
10	56	9	9	5	Active and alert.
11	48	5	5	4	Good.
12	48	0	19	5	Active and alert.
13	54	16	16	3	Active and alert.
14	54	12	12	4	Good.
15	53	6	14	6	Good.
16	54	9	9	5	Good.
17	54	4	17	5	Active and alert.
18	55	13	13	4	Active and alert.



Chart 14

Hamster No. 30

Saline Solution

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	64	---	14	---	Operative time 15 minutes.
1	68	11	11	3	Extremely active.
2	66	5	10	6	Good. Sutures in place. Incision healing well.
3	67	8	8	2	Good. Incision closed.
4	64	4	4	4	Good. Incision healing well.
5	64	1	16	3	Active and alert.
6	63	12	12	4	Active and alert.
7	63	8	8	4	Active and alert.
8	63	4	8	4	Active and alert.
9	63	4	12	4	Active and alert.
10	63	6	10	6	Active and alert.
11	60	5	5	5	Active and alert.
12	60	0	18	5	Active and alert.
13	64	15	15	3	Active and alert.
14	64	12	12	3	Active and alert.
15	63	6	14	6	Active and alert.
16	61	8	8	6	Active and alert.
17	61	2	16	6	Active and alert.
18	61	12	12	4	Active and alert.
19	61	8	18	4	Active and alert.





## Chart 15

Hamster No. 36

Saline Solution

Bilateral Adrenalectomy

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	61	---	13	---	Operative time 20 minutes.
1	59	12	12	1	Good. Active and alert.
2	58	7	11	5	Good. Incision healing well. Active and alert.
3	58	7	7	4	Active and alert.
4	55	4	4	3	Incision healing well.
5	55	1	14	3	Active and alert.
6	54	11	11	3	Active and alert.
7	54	7	9	4	Active and alert.
8	54	6	6	3	Active and alert.
9	54	1	14	5	Active and alert.
10	52	9	9	5	Active and alert.
11	54	5	5	4	Active and alert.
12	54	0	14	5	Active and alert.
13	54	10	10	4	Active and alert.
14	54	6	12	4	Active and alert.
15	53	6	10	6	Active and alert.
16	52	5	5	5	Active and alert.
17	52	0	15	5	Active and alert.
18	54	11	11	4	Active and alert.
19	54	6	17	5	Active and alert.



## Chart 16

Hamster No. 5

Tap Water

Operated Control

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	61	--	21	--	Operative time 35 minutes.
1	60	14	14	7	Active. No sign of infection.
2	60	11	14	3	Good.
3	60	11	11	3	Good.
4	60	8	20	3	Good.
5	61	17	17	3	Good.
6	60	13	13	4	Good.
7	59	7	14	6	Good.
8	60	10	10	4	Good.
9	59	5	17	5	Good.
10	58	11	11	6	Good.
11	58	6	15	5	Good.
12	59	12	12	3	Good.
13	59	9	15	3	Good.
14	58	11	11	4	Good.
15	57	7	7	4	Good.
16	56	4	17	3	Good.
17	58	13	13	4	Good.
18	57	9	9	4	Good.
19	57	5	13	4	Good.





( Cont. )

Hamster No. 5

Days Post-Op.	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
21	57	5	5	5	Good.
22	57	0	16	5	Good.
23	58	7	10	9	Good.
24	59	5	9	5	Good.
25	57	5	5	4	Good.
26	57	1	15	4	Good.
27	54	14	14	1	Good.
28	58	8	13	6	Good. Incision almost completely covered by new hair growth.
29	60	10	10	3	Good.
30	59	5	5	5	Good.

The animal is still alive, but the food intake and body weight determinations were discontinued thirty days after the operation.



Chart 17

Hamster No. 32

Tap Water

Normal Control

Days	Wgt. (gm.)	Food Left (gm.)	Food Added (gm.)	Food Intake (gm.)	Condition
0	50	--	10	--	Good.
1	51	9	9	1	Good.
2	55	3	12	6	Good.
3	56	11	11	1	Good.
4	55	8	8	3	Good.
5	55	4	15	4	Good.
6	58	9	9	6	Good.
7	58	4	10	5	Good.
8	58	0	17	10	Good.
9	57	12	12	5	Good.
10	57	7	7	5	Good.
11	57	1	15	6	Good.
12	62	11	11	4	Good.
13	62	8	14	3	Good.
14	62	8	14	6	Good.

# Table 1

Summary of data for the first 100 observations.

Continued on next page.

Observation	Group 1		Group 2		Total
	Mean	Std. Dev.	Mean	Std. Dev.	
1	1.2	0.5	1.5	0.6	2.7
2	1.1	0.4	1.4	0.5	2.5
3	1.3	0.6	1.6	0.7	2.9
4	1.0	0.3	1.3	0.4	2.3
5	1.4	0.7	1.7	0.8	3.1
6	1.2	0.5	1.5	0.6	2.7
7	1.1	0.4	1.4	0.5	2.5
8	1.3	0.6	1.6	0.7	2.9
9	1.0	0.3	1.3	0.4	2.3
10	1.4	0.7	1.7	0.8	3.1
11	1.2	0.5	1.5	0.6	2.7
12	1.1	0.4	1.4	0.5	2.5
13	1.3	0.6	1.6	0.7	2.9
14	1.0	0.3	1.3	0.4	2.3
15	1.4	0.7	1.7	0.8	3.1
16	1.2	0.5	1.5	0.6	2.7
17	1.1	0.4	1.4	0.5	2.5
18	1.3	0.6	1.6	0.7	2.9
19	1.0	0.3	1.3	0.4	2.3
20	1.4	0.7	1.7	0.8	3.1
21	1.2	0.5	1.5	0.6	2.7
22	1.1	0.4	1.4	0.5	2.5
23	1.3	0.6	1.6	0.7	2.9
24	1.0	0.3	1.3	0.4	2.3
25	1.4	0.7	1.7	0.8	3.1
26	1.2	0.5	1.5	0.6	2.7
27	1.1	0.4	1.4	0.5	2.5
28	1.3	0.6	1.6	0.7	2.9
29	1.0	0.3	1.3	0.4	2.3
30	1.4	0.7	1.7	0.8	3.1
31	1.2	0.5	1.5	0.6	2.7
32	1.1	0.4	1.4	0.5	2.5
33	1.3	0.6	1.6	0.7	2.9
34	1.0	0.3	1.3	0.4	2.3
35	1.4	0.7	1.7	0.8	3.1
36	1.2	0.5	1.5	0.6	2.7
37	1.1	0.4	1.4	0.5	2.5
38	1.3	0.6	1.6	0.7	2.9
39	1.0	0.3	1.3	0.4	2.3
40	1.4	0.7	1.7	0.8	3.1
41	1.2	0.5	1.5	0.6	2.7
42	1.1	0.4	1.4	0.5	2.5
43	1.3	0.6	1.6	0.7	2.9
44	1.0	0.3	1.3	0.4	2.3
45	1.4	0.7	1.7	0.8	3.1
46	1.2	0.5	1.5	0.6	2.7
47	1.1	0.4	1.4	0.5	2.5
48	1.3	0.6	1.6	0.7	2.9
49	1.0	0.3	1.3	0.4	2.3
50	1.4	0.7	1.7	0.8	3.1
51	1.2	0.5	1.5	0.6	2.7
52	1.1	0.4	1.4	0.5	2.5
53	1.3	0.6	1.6	0.7	2.9
54	1.0	0.3	1.3	0.4	2.3
55	1.4	0.7	1.7	0.8	3.1
56	1.2	0.5	1.5	0.6	2.7
57	1.1	0.4	1.4	0.5	2.5
58	1.3	0.6	1.6	0.7	2.9
59	1.0	0.3	1.3	0.4	2.3
60	1.4	0.7	1.7	0.8	3.1
61	1.2	0.5	1.5	0.6	2.7
62	1.1	0.4	1.4	0.5	2.5
63	1.3	0.6	1.6	0.7	2.9
64	1.0	0.3	1.3	0.4	2.3
65	1.4	0.7	1.7	0.8	3.1
66	1.2	0.5	1.5	0.6	2.7
67	1.1	0.4	1.4	0.5	2.5
68	1.3	0.6	1.6	0.7	2.9
69	1.0	0.3	1.3	0.4	2.3
70	1.4	0.7	1.7	0.8	3.1
71	1.2	0.5	1.5	0.6	2.7
72	1.1	0.4	1.4	0.5	2.5
73	1.3	0.6	1.6	0.7	2.9
74	1.0	0.3	1.3	0.4	2.3
75	1.4	0.7	1.7	0.8	3.1
76	1.2	0.5	1.5	0.6	2.7
77	1.1	0.4	1.4	0.5	2.5
78	1.3	0.6	1.6	0.7	2.9
79	1.0	0.3	1.3	0.4	2.3
80	1.4	0.7	1.7	0.8	3.1
81	1.2	0.5	1.5	0.6	2.7
82	1.1	0.4	1.4	0.5	2.5
83	1.3	0.6	1.6	0.7	2.9
84	1.0	0.3	1.3	0.4	2.3
85	1.4	0.7	1.7	0.8	3.1
86	1.2	0.5	1.5	0.6	2.7
87	1.1	0.4	1.4	0.5	2.5
88	1.3	0.6	1.6	0.7	2.9
89	1.0	0.3	1.3	0.4	2.3
90	1.4	0.7	1.7	0.8	3.1
91	1.2	0.5	1.5	0.6	2.7
92	1.1	0.4	1.4	0.5	2.5
93	1.3	0.6	1.6	0.7	2.9
94	1.0	0.3	1.3	0.4	2.3
95	1.4	0.7	1.7	0.8	3.1
96	1.2	0.5	1.5	0.6	2.7
97	1.1	0.4	1.4	0.5	2.5
98	1.3	0.6	1.6	0.7	2.9
99	1.0	0.3	1.3	0.4	2.3
100	1.4	0.7	1.7	0.8	3.1

Figure 11  
Pre-operative Set-up



Figure 12  
Ether Chamber







Figure 13  
Hamster On Frog Board





Figure 14  
Skin Incision







# LANDMARKS FOR OPERATION

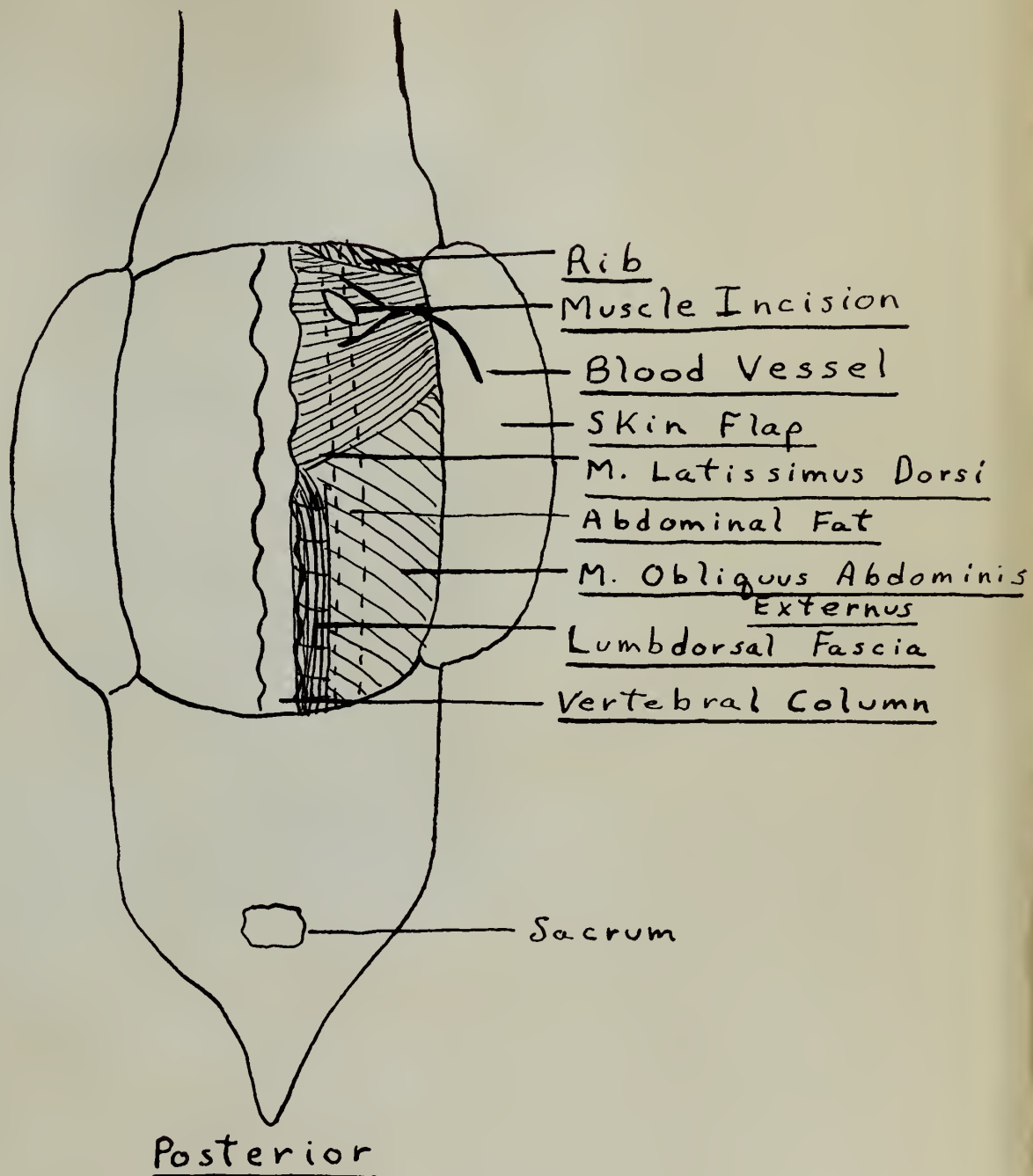




Figure 15  
Muscle Incision





Figure 16

Cross Section Of Hamster At Level Of Third Lumbar Vertebra

Dorsal

Right



Left





Figure 17  
Exposure Of Adrenal



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Figure 18  
Muscle Suture



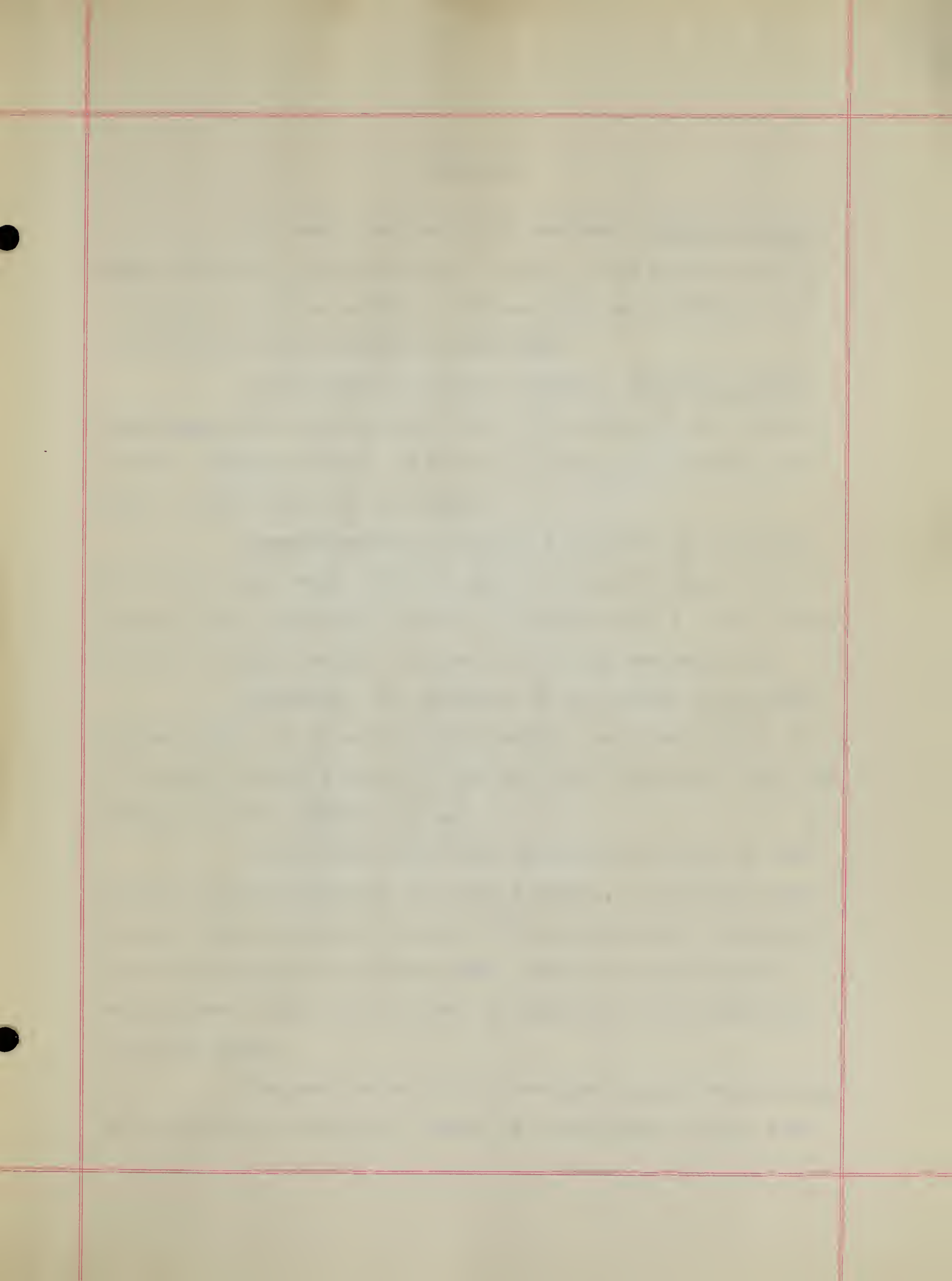




Figure 19  
Skin Suture









## ABSTRACT

At least one species of hamster, Cricetus frumentaris, exhibits cyclic seasonal activity. The animals display a decline of general activity between March and September, and the reverse between September and March.

After birth the golden hamster, Cricetus auratus Waterhouse, does not continue the rapid growth of the prenatal period. Sexual maturity is reached at the age of thirty-six days, in both the male and female.

Gonadotrophins stimulate the growth of the male sex organs, the ovary, and the female accessory organs; the peak of reactivity being reached at sixteen days of age, thirty-six days of age, and six and ten days of age respectively.

Androgens and estrogens do not affect the growth of the ovary, but do affect the growth of male sex organs and the female accessory organs. The peaks of reactivity being the same as that for gonadotrophins.

It has been found that the estrous cycle of the hamster can be determined by vaginal smears. The cycle lasts for four days, proestrus lasting for approximately three hours, estrus approximately fifteen hours, metestrus approximately twenty-seven hours, and diestrus or metestrus B approximately fifty-one hours.

Estrous cycles may be provoked in anestrus females by injection of estrogens. There is a difference in the his-





tological picture of the estrous smear provoked in anestrus females, and that of the estrus smear provoked in ovariectomized females.

Gonadotrophins are effective in provoking estrus in immature animals as well as in adults.

A sex-difference in the histology of the adrenal cortex of the hamster is described. The conspicuous feature of the cortex is non-sudanophilic vacuoles. Temperature change in the environment results in a change of the histological appearance and activity of the cortex. It seems that androgens have a specific hormonal effect on the adrenal cortex; whereas, it is uncertain whether estrogens exert any hormonal effect on the adrenal cortex.

An operative technique for bilateral adrenalectomy of the hamster is described. The possibility that golden hamsters are able to survive bilateral adrenalectomy, without administration of cortical hormone or electrolytic salts is presented.



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1. The first part of the paper is devoted to a general discussion of the problem.

2. In the second part, we shall consider the case of a single particle.

3. The third part is devoted to the case of a system of particles.

4. In the fourth part, we shall discuss the question of the stability of the system.

5. The fifth part is devoted to the case of a system of particles.

6. In the sixth part, we shall discuss the question of the stability of the system.

7. The seventh part is devoted to the case of a system of particles.

8. In the eighth part, we shall discuss the question of the stability of the system.

9. The ninth part is devoted to the case of a system of particles.

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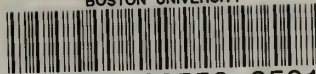
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